TRW Environmental
Safety Systems Inc.

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Civilian Radioactive Waste Management System
Management & Operating Contractor

NEVADA POTENTIAL REPOSITORY PRELIMINARY TRANSPORTATION STRATEGY STUDY 1

B00000000-01717-4600-00023 REV 01

Civilian Radioactive Waste Management System

Management & Operating Contractor

B&W Fuel Company
Duke Engineering & Services, Inc.
E. R. Johnson Associates, Inc.
Fluor Daniel, Inc.
INTERA Inc.
JK Research Associates, Inc.
Logicon RDA
Morrison-Knudsen Corporation
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Office of Civilian Radioactive Waste Management
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April 1995

Prepared for:

U.S. Department of Energy
Yucca Mountain Site Characterization Project
P.O. Box 98608
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Under Contract Number
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Civilian Radioactive Waste Management System
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April 1995

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Paul Standish, IRG, provided institutional and technical support. Jeff Pullen, Morrison-Knudsen, provided technical input. Ed McCann, Science Applications International Corporation, provided environmental input (National Environmental Policy Act process, regulatory, licensing, and land access). T. C. Smith, E. R. Johnson Associates, provided program transportation input.

Maps in the study were developed by EG&G, specifically Matt Walo, Dave Walrath, and Dave Brickey, with coordination by Sue Ross.

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EXECUTIVE SUMMARY

Limited feasible options exist when considering the shipment of spent nuclear fuel and high-level radioactive waste. These options are rail or truck; because of the weight associated with transportation casks (68.0 to 113.4 tonnes/75 to 125 tons), heavy-haul trucks are also considered. Yucca Mountain currently lacks rail service or an existing right-of-way for rail; it also lacks a dedicated highway suitable for heavy-haul trucks. Approximately 11,230 shipments by rail are planned from waste producer sites to Nevada, with an additional 1,041 shipments by legal-weight truck from four reactor sites not capable of upgrading for rail shipment.

This study identifies the reasonable alternatives for waste transport to the potential repository site, describes the evaluation process performed to identify those alternatives, and discusses the reasons for elimination of transportation routes deemed to be not reasonable. It provides information for a comparative review of the technical and institutional merits of the reasonable alternatives; however, additional data must be collected to provide "substantial treatment" to each alternative, as required by the National Environmental Policy Act (NEPA). The data to be collected are identified in the Recommendations section of this study.

The study concluded that heavy haul truck transportation is feasible – cost is very favorable when compared to rail – but route restrictions must be further evaluated. Heavy-haul trucks are capable of hauling loads equivalent to those by rail. Three heavy-haul truck routes were identified and evaluated. Of the three, one route will require careful planning to ensure that the heavy haul tractor and trailer selected for transport of the multi-purpose canister satisfy the reduced weight bearing frost limitations (legal weight axle limit) imposed. A second route has a wide load restriction, and the third is in a high population area with vehicular congestion. In addition to restrictions due to seasonal weather conditions, specific routes have additional restrictions, including no travel on holidays or weekends, and travel during daylight hours only.

Further restrictions will be imposed by the U.S. Department of Transportation based on routing of radioactive materials by highway. In brief, regulations state that interstate highways and interstate system beltways around cities are preferred routes, unless the state designates an alternative. If no preferred route is designated, the route selected must be the shortest distance to the delivery location from the nearest preferred route exit location. This applies to any radioactive material shipment, including legal-weight truck shipments.

Operation and maintenance costs for heavy-haul over a 24-year period, based on preliminary information, were calculated on an estimated operational cost of $15,000 per trip, with an estimated 468 trips per year average (11,230 total trips), for an estimated cost of $171 million to $173 million, depending on the route used. Because the initial costs and the total system life cycle costs of heavy-haul are approximately 50 percent lower than the lowest rail cost, this option will continue to be evaluated.

The study re-evaluated 13 previously identified rail routes and evaluated a new route called the Valley Modified Route, which was added due to recent discussions with U.S. Bureau of Land Management Las Vegas District personnel regarding the status of two potential Wilderness Areas. The routes were categorized in tabular form, shown in the Rail Route Status table. Status categories created are:

Recommended for Detailed Evaluation — These rail routes constitute the most reasonable route alternatives based on the conclusions of the Preliminary Rail Access Study (YMP 1990b) and this study. They are considered reasonable based on minimal land use conflicts, maximal use of favorable topography and Federal land, avoidance of land Federally withdrawn from public use, direct access to a major regional carrier, and conditions allowing design in accordance with accepted rail engineering practices.

Eliminated From Detailed Evaluation - Monitor — These rail routes fail to meet one or more of the evaluation criteria listed in the previous paragraph. They are considered technically feasible, but known or potential land use conflicts, only indirect access to a major regional carrier, or conflict with land Federally withdrawn from public use significantly reduce the potential for these routes to be successfully developed. The routes will be maintained at the present level of development, and the conditions that caused the route to be placed in this category will be monitored. Should conditions change that would significantly increase the potential for a route to be successfully developed, the route status will be re-evaluated.

Eliminated From Further Study — These rail routes fail to meet one or more of the evaluation criteria listed in the recommended status category, and the study has determined that the unfavorable condition eliminates any potential for the route to be successfully developed. The routes will be maintained at the present level of development and will be presented in the NEPA scoping process with the route alternatives assigned to the other two status categories. During the NEPA scoping process, these rail routes will be discussed briefly to identify the reasons for their elimination.

Rail Route Status

Route Status	Recommended for Detailed Evaluation	Eliminated From Detailed Evaluation–Monitor	Eliminated From Further Study
Caliente	●		
Carlin	●		
Jean	●		
Valley Modified	●		
Lincoln County A and B			●
Mina		●	
Cherry Creek		●	
Dike		●	
Arden			●
Valley			●
Ludlow			●
Crucero			●
Lincoln County C			●

Development of a branch rail line from an existing main line requires integrated performance of the NEPA process, conceptual design, land access, and construction. Conceptual design must be initiated in the early stages of the NEPA process to support environmental impact statement (EIS) development.

Study findings indicate that conceptual design of a rail system must be started at the beginning of fiscal year 1996 and completed by the beginning of fiscal year 1997. In addition, conceptual design must be performed on all remaining alternatives identified in the EIS. The study team evaluated EIS development with additional analysis of a transportation system and EIS development without additional analysis.

Land access must be integrated with the design and must be completed prior to construction. Formal land access activities such as land withdrawal or right-of-way acquisition cannot be completed until the EIS has been finalized; however, negotiations can begin during the EIS process.

Rail construction costs are directly related to route length. Preliminary estimates for rail capital costs range from $355 million for the Valley Modified route to $1.4 billion for the Caliente Option A route.

The rail routes recommended for detailed evaluation, and the heavy-haul routes identified in this study, have been comparatively evaluated against the Preliminary Rail Access Study (YMP 1990b) selection criteria. The selected routes have been additionally evaluated using the following preliminary criteria developed by the study team:

- Ease of construction
- Initial cost
- Safety
- Flexibility for personnel and freight
- Operating and maintenance costs
- Safeguards and security
- Public perception.

Only obviously favorable and unfavorable attributes of the routes have been identified; attributes which did not have an obvious favorable or unfavorable comparative value were given a neutral designation. Evaluation criteria for route selection and design will be finalized during the NEPA scoping process after all affected groups have been permitted to provide input. This study cannot select a preferred route because:

- The U.S. Department of Energy must weight the criteria established to evaluate tradeoffs.

- The information on which the ratings are based is preliminary and subject to change with additional research.

- Acceptability by affected units of local government was not evaluated; this will occur during the NEPA process.

- Environmental impact was not evaluated; this will occur during the NEPA process.

Institutional involvement in the transportation system development will include interaction with the affected communities and governing agencies, such as the U.S. Department of the Interior, Bureau of Land Management, U.S. Interstate Commerce Commission, U.S. Environmental Protection Agency, U.S. Department of Transportation, U.S. Department of Defense, U.S. Fish and Wildlife Service, and the Nuclear Regulatory Commission. These sessions will focus on access plans and potential alignments and will include requests for any recommendations they have for evaluation.

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1. INTRODUCTION

1.1 STUDY OBJECTIVE AND APPROACH

The objectives of this study are to (1) provide guidance on the steps necessary to develop a system within Nevada to transport spent nuclear fuel and high-level radioactive waste from nodes entering the state to the potential repository site at Yucca Mountain; and (2) provide information on existing conditions within the state that affect selection of a transportation system. To meet these objectives, the following study approach was used:

- Conclusions of previous studies were reviewed.
- The rail line acquisition process was determined.
- Land issues were identified.
- The design and construction process was documented, and a schedule was developed to identify the process duration.
- The NEPA process was identified, process durations were established, and ties to the design and construction process were identified.
- Rail line management approach options were developed.
- Rail line cost drivers were identified and preliminary cost estimates for proposed routes were updated.
- Nuclear-specific transportation issues were addressed.
- Heavy-haul truck transport was evaluated as an alternative transportation system.

The study incorporated input from personnel in the areas of surface and subsurface design, environmental, program transportation, and institutional.

1.2 TRANSPORTATION STUDY BACKGROUND

The U.S. Department of Energy (DOE) has been directed by the U.S. Congress (in the Nuclear Waste Policy Amendments Act) to study Yucca Mountain, located on the southwestern edge of the Nevada Test Site, as a potential site for nuclear waste disposal. The site lacks rail service or an existing right-of-way for a branch rail line. If the site is found suitable and is licensed by the Nuclear Regulatory Commission (NRC) for a spent nuclear fuel and high-level radioactive waste disposal site, adequate highway access and rail service will be essential to the safe transportation of the waste. This is particularly true now because DOE is developing multi-purpose canisters (MPCs) to accommodate storage, shipment, and disposal of spent nuclear fuel.

The loaded transportation cask with an MPC will weigh approximately 68.0 tonnes (75 tons) or 113.4 tonnes (125 tons), and the loaded transportation casks for high-level radioactive waste weigh approximately 90.7 tonnes (100 tons). This will require transportation by either rail or heavy-haul truck. In addition, some utility sites (a minimum of four) will not be capable of handling an MPC and will require legal-weight truck transport for the spent nuclear fuel. Therefore, development of highway access to the repository site from the existing highway (U.S. Highway 95) will still be necessary.

This study reviewed a number of studies that evaluated aspects of Nevada's transportation capabilities. A DOE report identified possible points of highway entry into Nevada as well as intrastate access routes (1989). The report also estimated the number of highway shipments of spent nuclear fuel and high-level radioactive waste to the potential repository at Yucca Mountain. The University of Nevada, Reno, contracted by the Nevada Department of Transportation, is currently evaluating the use of alternative highways to Nevada's interstate system for transporting spent nuclear fuel and high-level radioactive waste.

Highway and rail accidents have been addressed in several studies. The Yucca Mountain Site Characterization Project (YMP) characterized and documented Nevada highway and rail accidents (1990a), and performed a detailed analysis of Nevada highway accident characteristics (1991c). A review of accident and incident experience for commercial spent nuclear fuel shipments in Nevada included an historic overview of these shipments (YMP 1991a).

Several studies have evaluated Nevada rail options. A U.S. Atomic Energy Commission study determined the technical and economic feasibility of constructing and operating a railroad from Las Vegas to Mercury (1962). The Preliminary Rail Access Study identified and evaluated 10 rail alignment options (YMP 1990b). A YMP study provided a description of the operational and physical characteristics of the current Nevada railroad system (1991b). A Raytheon Services Nevada report explored the rationale for a potential high-speed rail corridor between Las Vegas and the Nevada Test Site to accommodate personnel (1994).

A Science Applications International Corporation study developed the conceptual design of the Caliente rail route option (1992). The study provided a preliminary environmental analysis and prepared conceptual cost estimates.

Additional details on each of these studies are included in Appendix C.

2. CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM TRANSPORTATION SYSTEM OVERVIEW

The transportation of spent nuclear fuel and high-level radioactive waste will be accomplished by contracting with private industry for transport by highway, rail, barge, and for intermodal services. See Figure 2-1 for rail shipment initiation points. Initiation points are identified according to the type of shipment: high-level waste, 68-tonne (75-ton) MPC, and 113.4-tonne (125-ton) MPC. At least four sites will require shipment by legal-weight truck. Highway carrier services for legal-weight trucks would consist of providing specially-designed legal-weight tractor-trailers, highly qualified and trained drivers, and dispatch services. At a minimum, drivers must meet all requirements in 49 Code of Federal Regulations (CFR) 391, Qualification of Drivers, and 49 CFR 383, Commercial Driver's License Standards. Additional driver training may be required by the Civilian Radioactive Waste Management System (CRWMS) through a comprehensive driver training course.

Rail carrier service consists of providing rail cars for cask transport, buffer cars (required by 49 CFR 174), a prime mover (locomotive), and possibly a rail car suitable for in-transit physical security/escort personnel and equipment. Equipment associated with rail shipments from the purchaser/producer sites may be purchased, leased, or rented by the Office of Civilian Radioactive Waste Management (OCRWM) and will be moved by the commercial railroad industry. Special training requirements for railroad operating personnel will be coordinated with the railroads for the handling of hazardous waste (49 CFR 174.7). Most shipments will involve several commercial railroad carriers.

If rail transportation casks can be used, but a direct rail connection is not available, intermodal transfer from heavy-haul truck to rail near the reactor sites may be used. This option is also being considered within Nevada because there is no rail line from a main line railroad to Yucca Mountain. Intermodal transfer is discussed further in Section 5.3.1. Another option for utility sites without direct rail access is barge transport. Each transportation operation presents its own unique challenges and planning considerations; therefore, each operation must be evaluated to ensure that operational costs, operational effectiveness, implementation time, and flexibility are considered.

In-transit physical security requirements for the CRWMS shipments will be documented in the planned OCRWM Safeguards and Security Plan currently under development, which is expected to implement the requirements described in 10 CFR 73.37. Security objectives are (1) early detection and assessment of attempts to gain access to or control over spent nuclear fuel; (2) notification to the appropriate response forces of any sabotage attempts; and (3) impediment of attempts at radiological sabotage of spent nuclear fuel shipments. The first objective is met by the use of threat analysis and the latter two are met by the use of escorts during transportation.

The total shipments are divided into four categories: 68.0-tonne (75-ton) MPC (2,312 shipments); 113.4-tonne (125-ton) MPC (6,311 shipments); high-level waste (2,607 shipments); and legal-weight truck (1,041 shipments).

2.1 LEGAL-WEIGHT TRUCK SHIPMENTS

The 1982 Surface Transportation Act defines legal-weight truck as a truck whose single-axle weight limit does not exceed 9,072 kg (20,000 pounds), tandem-axle weight limit does not exceed 15,422 kg (34,000 pounds), tridem-axle weight limit does not exceed 19,051 kg (42,000 pounds), and gross weight limit does not exceed 36,288 kg (80,000 pounds).

The issues and related activities described in the following sections are directly related to the shipment of spent nuclear fuel by legal-weight truck. Currently, there are no plans to ship high-level radioactive waste solidified in borosilicate glass by legal-weight truck. Plans are to ship this material from the producer sites to the repository by rail.

2.1.1 Legal-Weight Truck Issues

Because legal-weight trucks are classified as truck-trailer combinations weighing less than 36,288 kg (80,000 pounds) gross vehicle weight (GVW), a standard truck-tractor and trailer weighing approximately 16,330 kg (36,000 pounds) coupled with the projected weight of the General Atomics (GA) legal-weight truck casks of approximately 24,604 kg (54,000 pounds) could be 4,536 kg (10,000 pounds) over the legal weight limit. For this reason, the highway transport equipment planned to transport the casks must be custom tailored to reduce the GVW by approximately 4,536 kg (10,000 pounds). A development and testing program is underway for a special legal-weight truck tractor and trailer to transport the GA-4 and GA-9 casks. A preliminary sketch of the legal weight transporters for GA-4 and GA-9 casks is shown in Figures 2-2 and 2-3 (GA 1993), respectively. Other concerns affecting legal-weight truck transportation are discussed in the following sections.

2.1.2 Shipment Sources and Quantities

According to current DOE plans, between 4 percent and 11 percent of the spent nuclear fuel will be transported by legal-weight truck, which represents 2,000 to 7,000 metric tons of uranium (MTU) of the 63,000 MTU designated for the repository. The sources of this spent nuclear fuel are 4 to 19 nuclear reactor sites that may not be able to handle the rail transportation casks. These potential 19 sites (at 16 different locations) are identified in Figure 2-4 with brown dots (CRWMS M&O 1994a). The most favorable transportation scenario identified to date includes only four reactor sites (two locations) required to use legal-weight truck, identified on the figure with yellow dots (CRWMS M&O 1994b).

2.1.3 State-Designated Highway Routes

Designated highway routes proposed by the State of Nevada (see Section 3.3.1 for a description of the routes) could be used for the legal-weight truck transport of radioactive materials. Evaluation of the applicable state regulations did not identify any other regulatory requirements that would limit such shipments. Local ordinances that restrict transport of hazardous materials may impact the routing of shipments through some areas.

Figure 2-1. Spent Nuclear Fuel and High-Level Waste Sites and Rail Routes

N

Yucca Mountain
Site Characterization
Project

High Level Waste
75ton/125ton
Rail Map

(Based on 4 Reactor Legal Weight Truck Scenario)

- High Level Waste Site
- 75 ton Multi Purpose Canister
- 125 ton Multi Purpose Canister
- Mainline Railroad (DOT Class 1, Category A)

Sources:

Classificiations of Nuclear Sites were defined and providedby TRW, February 1995.

Nuclear Site Locations were provided by the US Department of Energy, Remote Sensing Laboratory, Emergency ResponseDivision, operated by EG&G Energy Measurements, Inc., Las Vegas, Nevada. February 1995.

States and Roads and railroad data obtained from the United States Geological Survey Digital Line Graph, scale 1:2,000,000.

Projection is Albers, Datum NAD27.

Map compiled April 1995, by EG&G Energy Measurements, Inc., Remote Sensing Laboratory.

In accordance with AP-5.1Q Para 5.2.2, the data on this map are PRELIMINARY - INFORMATION ONLY: YMP-SIII.3Q, Section 5.2.2 states that, "The data provided herein have not received complete technical and quality checks and, therefore, are considered to be preliminary only and cannot be used for licensing activities..."

YMP-95-052.3

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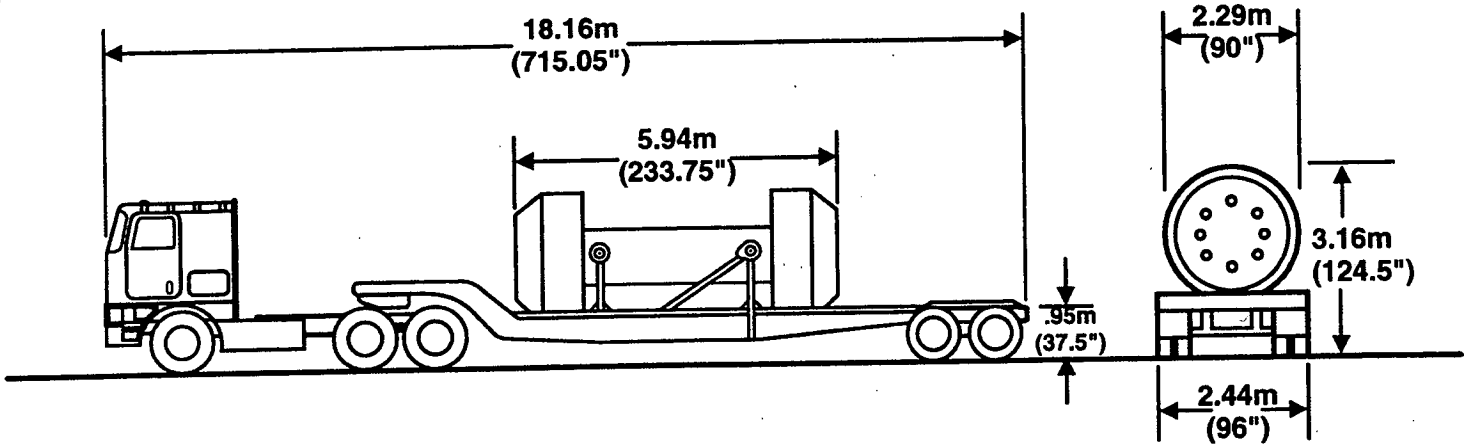
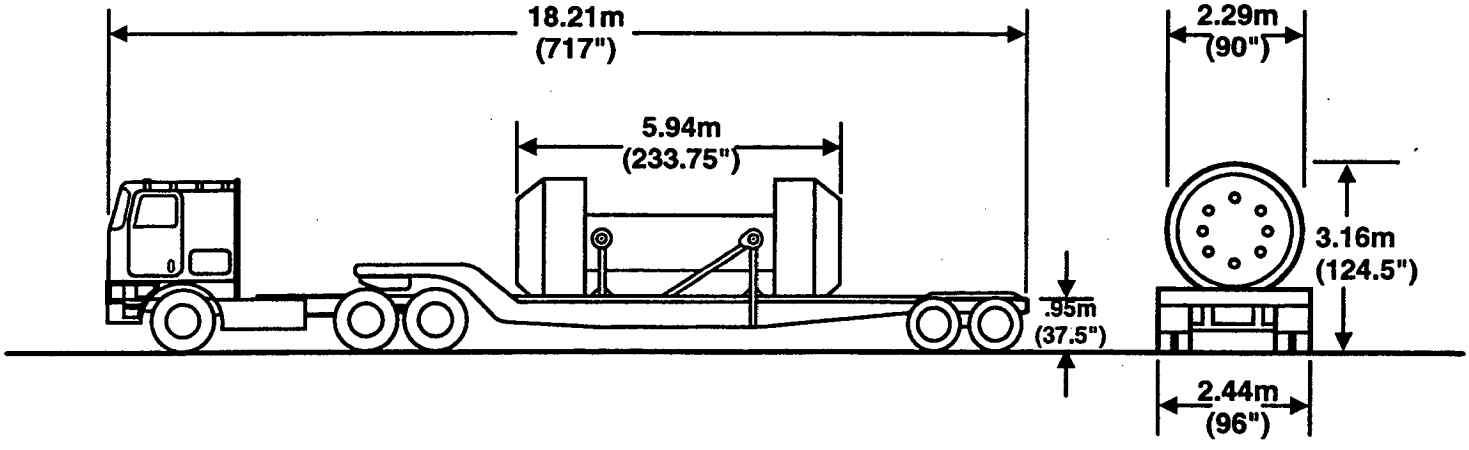


Estimated Gross Weight 35,944 kg (78,666 pounds)

Figure 2-2. Legal-Weight Transporters for GA-4 Casks



Estimated Gross Weight 35,683 kg (79,242 pounds)

Figure 2-3. Legal-Weight Transporters for GA-9 Casks

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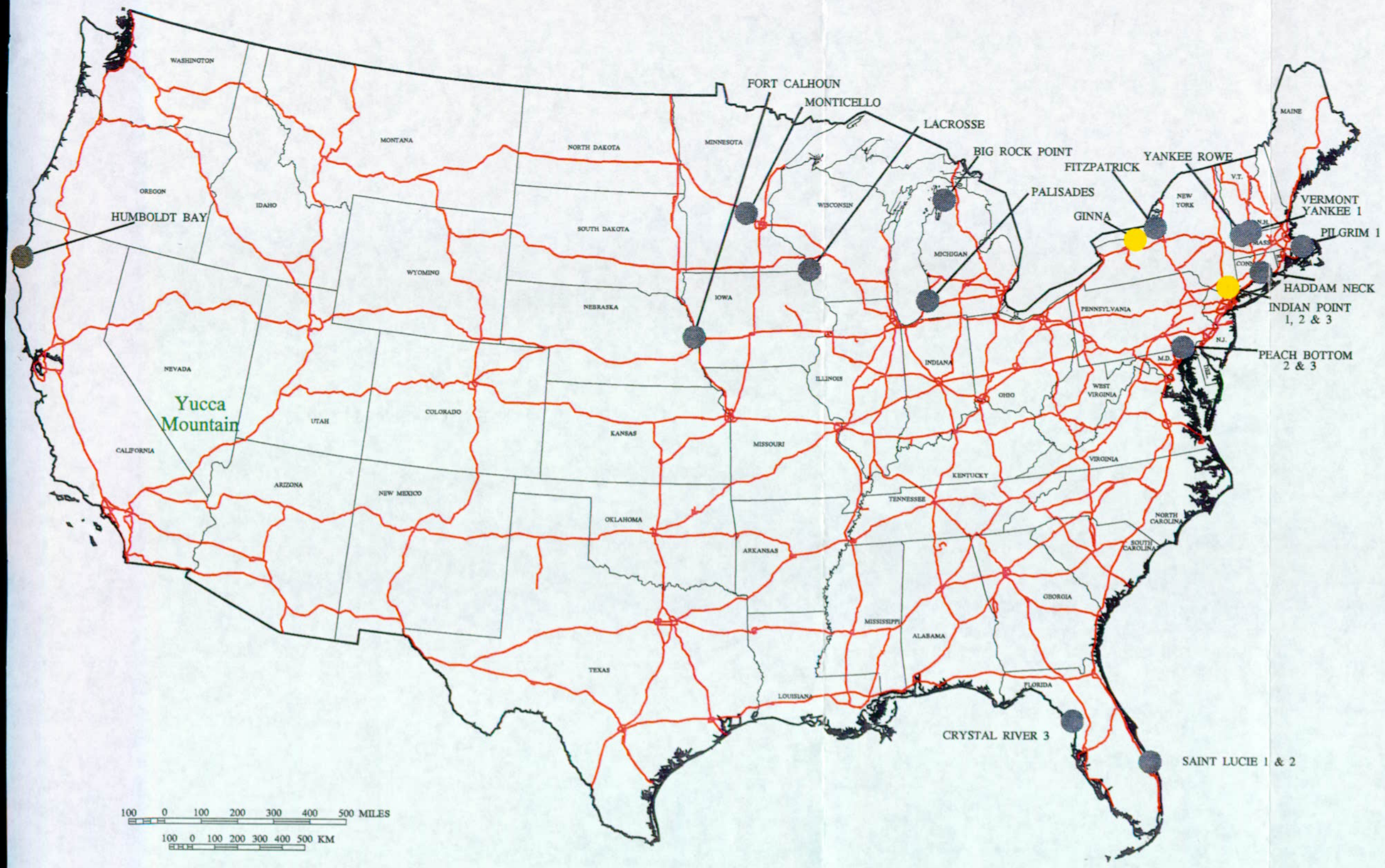

Figure 2-4. Nuclear Reactor Sites Requiring Truck Transport of Spent Nuclear Fuel

N

Yucca Mountain
Site Characterization
Project

Legal Weight Truck Highway Map

4 Reactor Scenario
Legal Weight Truck Sites

19 Reactor Scenario
Legal Weight Truck Sites

Interstate Highway

Sources:

Classificiations of Nuclear Sites were defined and provided by TRW, February 1995.

Nuclear Site Locations were provided by the US Department of Energy, Remote Sensing Laboratory, Emergency ResponseDivision, operated by EG&G Energy Measurements, Inc., Las Vegas, Nevada. February 1995.

States and Roads data obtained from the United States Geological Survey Digital Line Graph, scale 1:2,000,000.

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The Nevada Highway Routing Study (DOE 1989) identified the following local ordinances as applicable to transporting hazardous materials through Clark County and the City of Las Vegas:

- Clark County Ordinance No. 960 (County Code 75.30) regulates highway and railroad transportation hazardous materials, which are defined to include radioactive materials. The ordinance adopts the Federal hazardous material regulations and certain NRC regulations and requires shippers to adhere to county routing requirements.

- City of Las Vegas Ordinance No. 3190 also regulates the transportation of hazardous materials and contains provisions similar to the Clark County ordinance.

- City of North Las Vegas Ordinance No. 880 governs a wide range of hazardous material issues. Within the context of transportation, the ordinance addresses only the routing of hazardous material shipments and does not adopt the Federal hazardous material regulations.

Other local ordinances that could affect shipments may be adopted prior to shipment of radioactive materials to the site. The current status of local ordinances must be monitored for the proposed routes.

2.1.4 Access Road Construction and Existing Road Upgrade

Access to the Yucca Mountain area from the existing U.S. Highway 95 must be incorporated into the licensing process for the potential repository. Three options will be evaluated for this access: (1) use of the existing road from Mercury to the facility; (2) use of the existing road through Lathrop Wells Road to Area 25 of the Nevada Test Site; or (3) construction of a new access road, similar to the road that is located along the Fortymile Wash, shown conceptually in the Science Applications International Corporation report (1992). The use of existing roads may require some upgrades.

2.2 MULTI-PURPOSE CANISTER SHIPMENTS

2.2.1 Shipment Sources and Quantities

According to DOE planning of the 63,000 MTU designated for the repository, between 89 percent and 96 percent (56,000 - 60,500 MTU) will be transported by rail in MPC transportation casks. The sources of this spent nuclear fuel are the remaining nuclear reactor sites not identified in Section 2.1.2 for truck shipments. Plan and section views of the 68.0-tonne (75-ton) MPC and 113.4-tonne (125-ton) MPC and on rail cars are shown in Figures 2-5 and 2-6, respectively. A heavy-haul transporter capable of transporting the MPC or high-level waste cask is shown in Figure 2-7 along with a size comparison with other types of tractor-trailer combinations.

2.2.2 Environmental Impact Statement Discussion

The MPC Environmental Impact Statement (EIS) proposed action is to fabricate and deploy an MPC-based system for spent nuclear fuel. The DOE proposes to fabricate and deploy MPCs that consist of sealed metal containers capable of holding multiple spent nuclear fuel assemblies. Spent fuel stored in such containers would eventually be transported to a repository. Once at the repository, the spent fuel would remain in the sealed canister to be disposed of as part of the waste package. The basic characteristic of this system is that once the spent fuel is placed in the canister and sealed, it is not removed. The Notice of Intent for the MPC EIS was issued in the Federal Register on October 24, 1994. During scoping, which continued until January 6, 1995, three EIS scoping meetings were held to receive oral comments; various mechanisms were also available for the public to provide written comments. The DOE will address the comments and prepare a draft EIS, which is scheduled for issue to the public for comment in the fall of 1995; the final EIS is scheduled for issue in the fall of 1996.

2.3 HIGH-LEVEL WASTE TRANSPORTATION CASKS

Currently, there are no conceptual designs available to evaluate the overall size and weight of the high-level waste transportation casks. However, best available information, also used in the 1994 Total System Life Cycle Cost, is based on a 1989 report, "1994 MRS-to-Repository Transportation System Design Characterization and Capacity Study" (Jones and Nickell 1989).

This document describes the physical size and weight of the high-level waste transportation cask, with a cask capacity of five high-level waste canisters. Table 2-1 shows size and weight features.

Table 2-1. Size and Weight Features of High-Level Waste Canisters

	Meters	Inches
Cask Body Outside Diameter	2.47	97.4
Overall Length (Including Impact Limiter)	5.21	205.0
Diameter Across Impact Limiter	3.35	132.0
	Kilograms	Pounds
Loaded Weight	103,947	229,160
Unloaded Weight	93,061	205,160

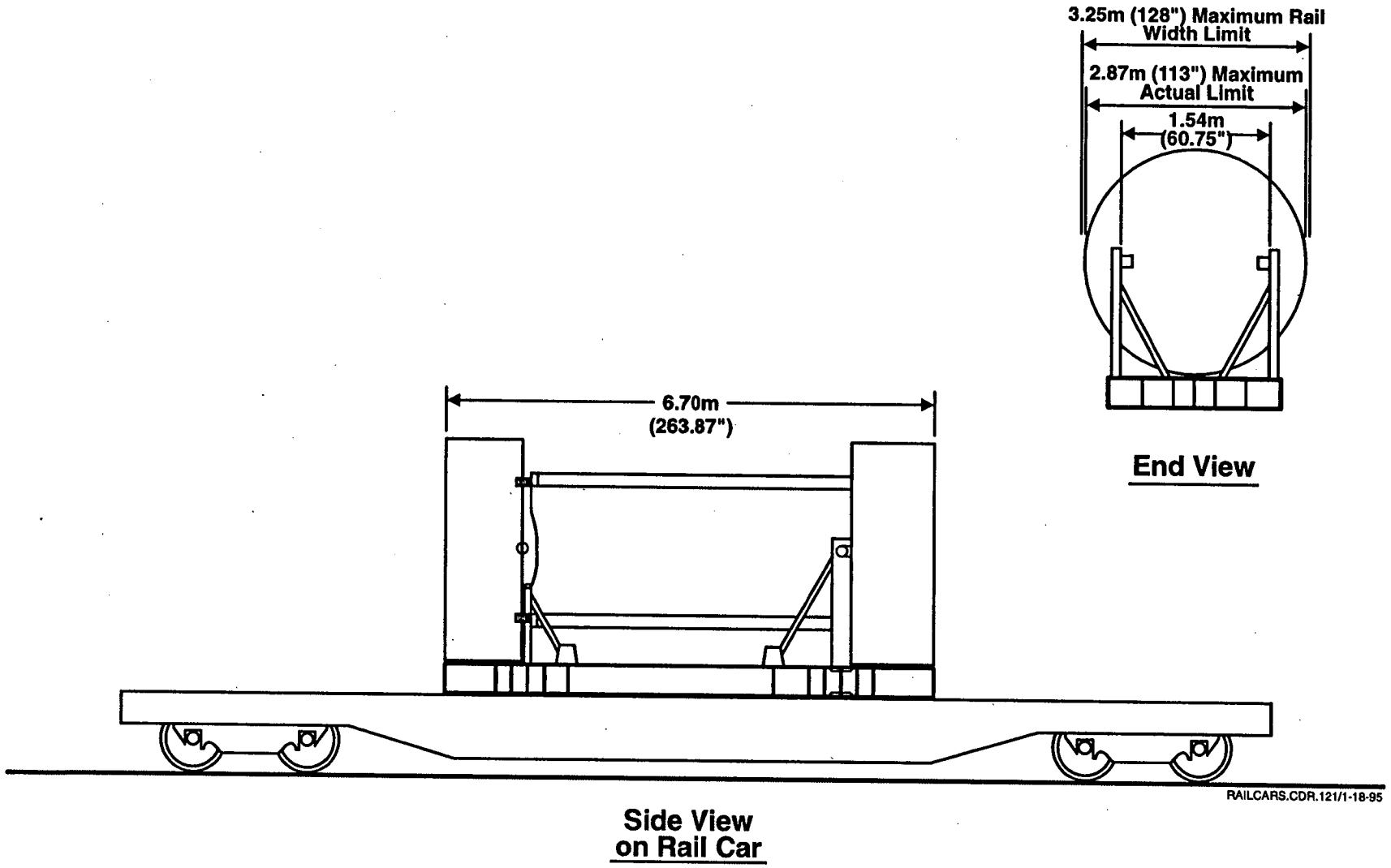


Figure 2-5. 68.0-tonne (75-ton) Multi-Purpose Canister — Plan and Section on Railcar with Dimensions

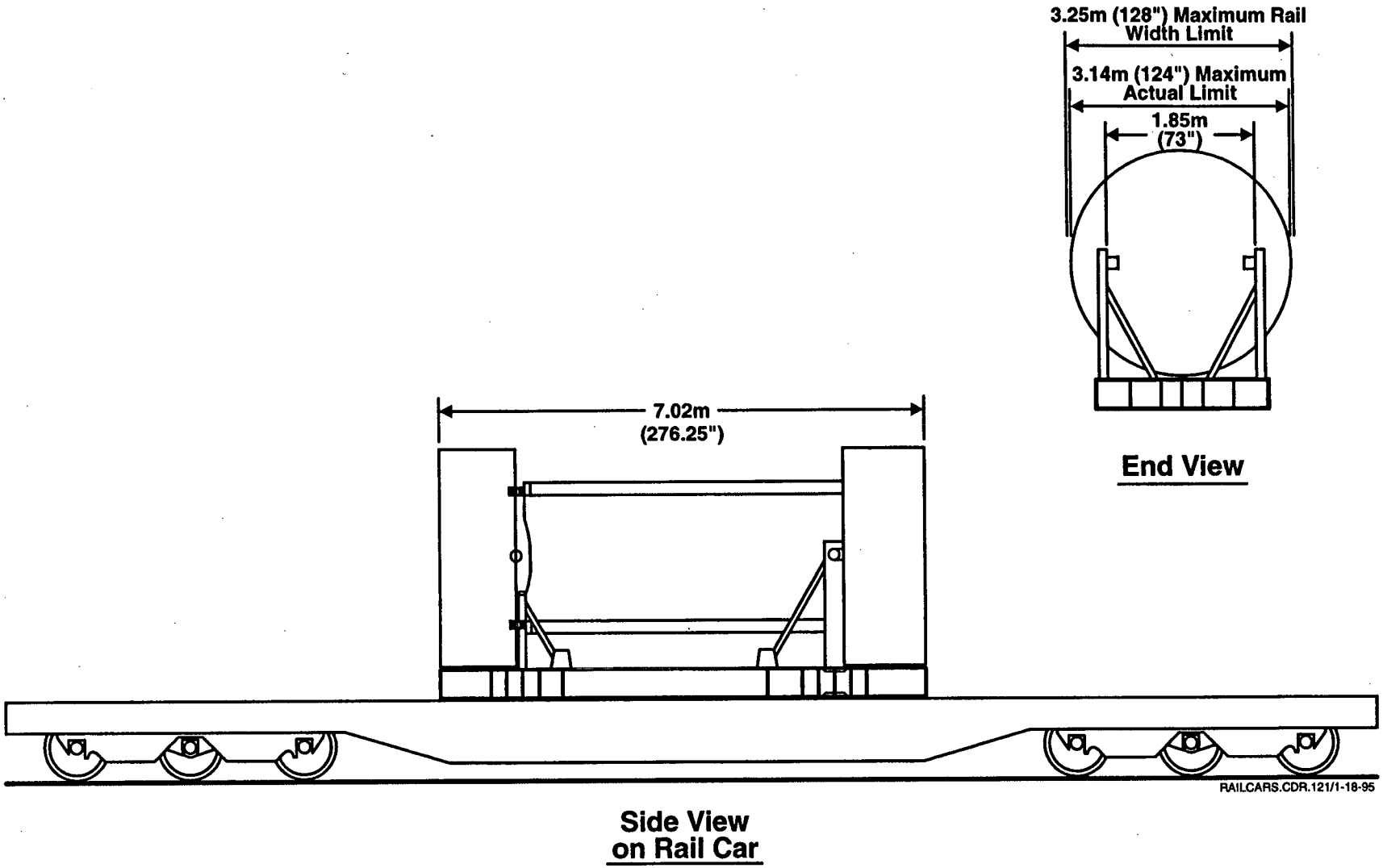
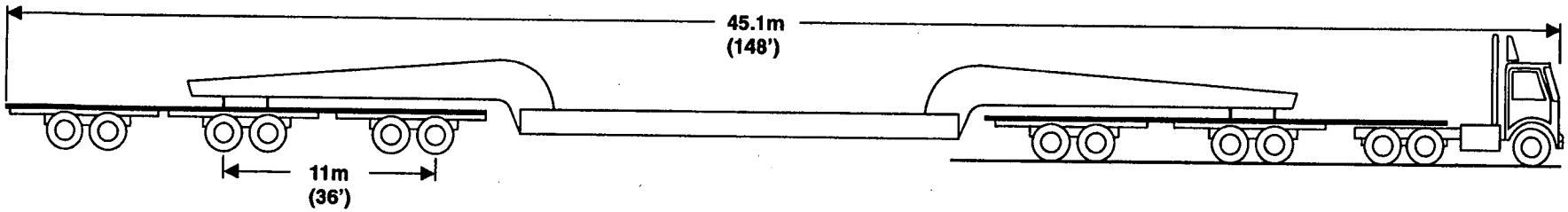
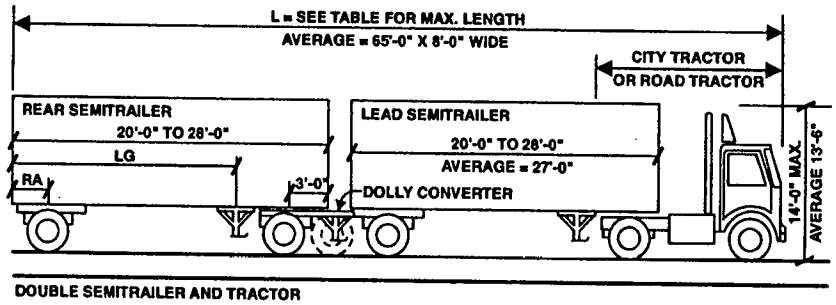


Figure 2-6. 113.4-tonne (125-ton) Multi-Purpose Canister — Plan and Section on Railcar with Dimensions

Heavy-Haul Transporter

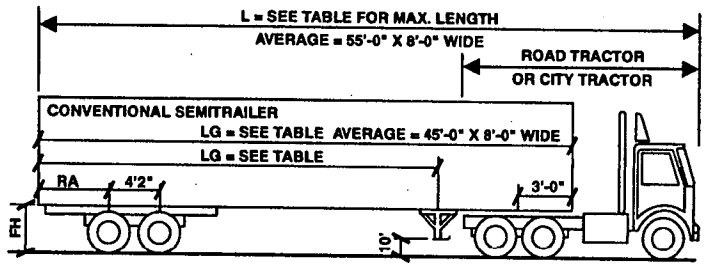


Double Semitrailer



DOUBLE SEMITRAILER AND TRACTOR

Conventional Semitrailer



SEMITRAILER AND TRACTOR
TIRE SIZE APPROX. 41" ± DIA. X 10" ± WIDE

AVERAGE DIMENSIONS OF VEHICLES

	TYPE OF VEHICLES			
	DOUBLE SEMITRAILER	CONVENTIONAL SEMITRAILER	STRAIGHT BODY TRUCK	VAN DELIVERY
Length (L)	65'0"	55'0"	17'0" to 35'0"	15'0" to 20'0"
Width (W)	8'0"	8'0"	8'0"	7'0"
Height (H)	13'6"	13'6"	13'6"	7'0"
Floor Height (FH)	4'0" to 4'6"	4'0" to 4'4"	3'0" to 4'0"	2'0" to 2'8"
Track (T)	6'6"	6'6"	5'10"	5'0" to 5'4"
Rear Axle (RA)	3'0" to 4'0"	4'0" to 12'0"	2'3" to 12'0"	-

RAILCARS.CDR.121/1-18-95

Figure 2-7. Heavy-Haul Transporter Comparison to Semitrailer and Tractor

A need also exists for the shipment of heavy disposal overpacks from the fabricator to Yucca Mountain. Table 2-2 shows transport options for each type of disposal container (CRWMS M&O 1994c).

Table 2-2. Disposal Containers by Size and Weight

Disposal Container For:	Overall Size	Weight (without lids)	Possible Transport Options
68.0-tonne (75-ton) MPC	1.531 m dia x 5.647 m	23,910 kg (52,697 lbs)	Rail or Overweight Truck
113.4-tonne (125-ton) MPC	1.802 m dia x 5.682 m	29,050 kg (64,026 lbs)	Rail or Overweight Truck
High-level waste	1.800 m dia x 3.763 m	20,230 kg (44,587 lbs)	Rail or Legal-Weight Truck

3. NEVADA TRANSPORTATION SYSTEM ALTERNATIVES

This section focuses on the transportation of spent nuclear fuel and high-level radioactive waste from reactor or waste source and the transportation of empty disposal containers to Yucca Mountain.

3.1 EXISTING HIGHWAYS FOR LEGAL-WEIGHT TRUCK SHIPMENTS

Highway routes are selected in accordance with 49 CFR Part 397, Subpart D. The Nevada Highway Routing Study (DOE 1989) provides information on the process required by the U.S. Department of Transportation (DOT) for selecting highway routes for shipments of highway route controlled quantity of radioactive materials in Nevada. The report also presents potential alternative waste shipment routes that could be considered by the State of Nevada during the next few years for designation as a preferred route. The report does not attempt to select routes for waste shipments to a potential repository at Yucca Mountain, because DOT regulations require that actual routes be selected by carriers close to the time of shipment. The OCRWM is working with DOE Environmental Restoration and Waste Management to develop, with public input, department-wide route selection criteria for highway and rail routes.

Potential highway routes based on the DOT regulations (49 CFR 397 Subpart D) are:

- Interstates 15 and 80
- U.S. Highway 95 to Yucca Mountain (shortest route to the potential site from the interstate highway system)
- Any in-state route designated to U.S. DOT by the State of Nevada as a preferred alternative highway.

The state would be required to designate any non-interstate roads as "preferred highway routes for highway route controlled quantity shipments of radioactive waste" in accordance with 49 CFR 397 Subpart D. The State of Nevada has proposed six alternate routes for the transport of radioactive material. These routes (shown in Figures 3-1 and 3-2) allow radioactive material to be transported from both the northern and southern parts of the state to the potential repository site. The proposed routes were developed assuming legal-weight truck transport; heavy-haul transport was not included in the evaluation. Formal designation of these routes by the state, however, may allow the heavy-haul transport to use those designated routes if the heavy-haul and hazardous materials permits are approved by the Nevada Department of Transportation. However, no formal designation has been made by the state at this time.

Transportation on Nevada roads from the northern part of the state has been proposed in Options A and B. Option A uses U.S. Highway 93 from Wendover, Nevada (northeast side of the state), to Nevada State Route 318, until it re-connects to U.S. Highway 93. The route continues on Craig Road (north of Las Vegas) to U.S. Highway 95, which provides direct access to the potential repository area. Option B also uses U.S. Highway 93 from Wendover,

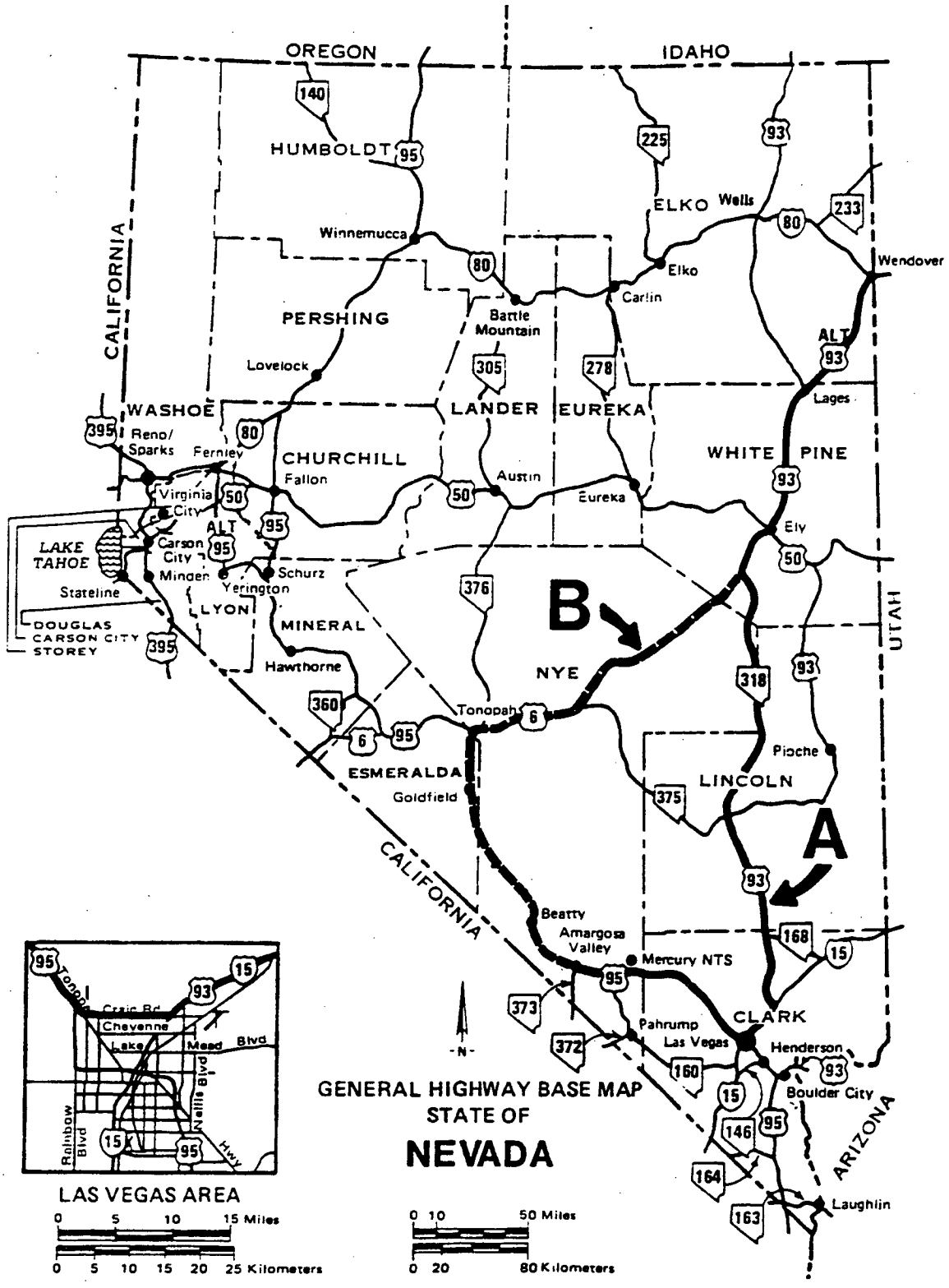


Figure 3-1. Road Route Options A and B

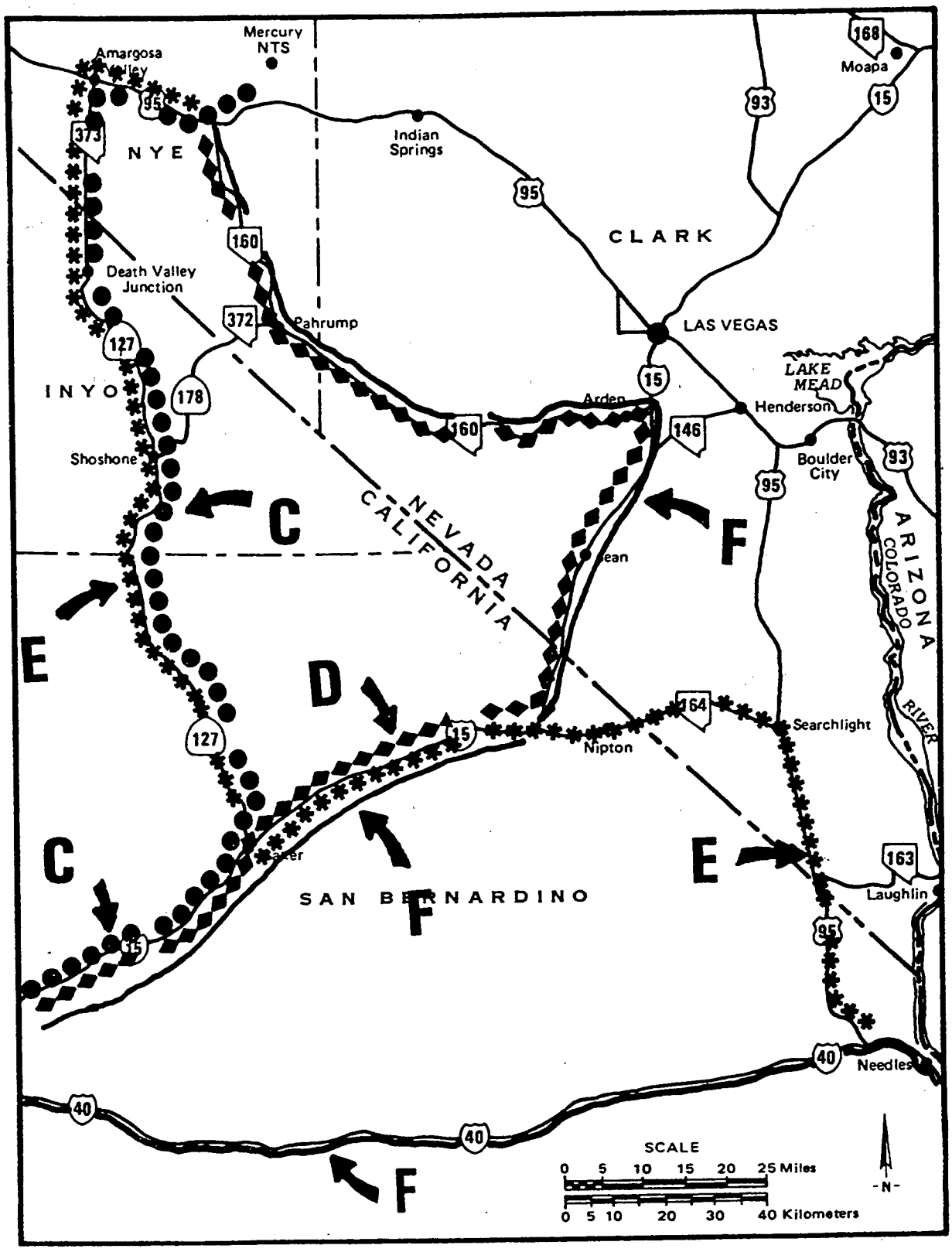


Figure 3-2. Road Route Options C through E

but veers onto U.S. Highway 6 north of the Nevada Test Site (instead of Highway 318), and connects to U.S. Highway 95 at Tonopah for direct access to the potential repository site.

Transportation on Nevada (and California) roads from the southern part of the state has been proposed in Options C through F. The route identified as Option C uses Interstate 15, then California State Route 127 through California's San Bernardino and Inyo counties to Amargosa Valley, Nevada, where U.S. Highway 95 is used to the potential repository site. California has not accepted the proposal to use California State Route 127 for transport of radioactive material. Option D also uses Interstate 15, with an exit onto Nevada State Route 160 at Arden, Nevada. Highway 160 connects with U.S. Highway 95 for direct access to the potential repository site. Option E is similar to Option C, except that Interstate 15 is accessed from U.S. Highway 95 at Needles, California, to Nevada State Route 184, which connects to Interstate 15 in California. Option F is similar to Option D, except that Interstate 15 is accessed from the east via Interstate 40.

3.2 RAIL SYSTEM

The following subsections describe selection guidance used in the Preliminary Rail Access Study (YMP 1990b) to select alternative rail routes and determine which routes were feasible. The evaluation guidance has been revisited in Section 3.2.6 to determine if recent changes in the status of land-use, rail carriers, or Federal land change the conclusions of that study.

3.2.1 Locations of Existing Railroads

Three major existing railroad lines through the State of Nevada (shown in Figure 3-3) could be used as connection points for a branch line to the potential repository.

One of the two northern routes is a Southern Pacific rail line that runs from Ogden, Utah, to Reno, Nevada. The Union Pacific railroad also accesses this line westward from Wells, Nevada, to Winnemucca, Nevada. The Southern Pacific runs on the more northerly Union Pacific track from Winnemucca to Wells. The Union Pacific cannot use the Southern Pacific line, except between Winnemucca and Wells. The Southern Pacific line runs through the Nevada cities of Elko, Battle Mountain, Winnemucca, and Lovelock. The Southern Pacific line has two branch lines that were considered for use in extending rail service to the potential repository; the Southern Pacific branch line to Mina, and the Nevada Northern branch line to Ely. The proposed rail routes to the potential repository using sidings along the Southern Pacific rail line are Carlin (with an interchange to the Union Pacific main line), Cherry Creek (using the Nevada Northern branch line), and Mina. The second northern rail line is the Union Pacific line that generally parallels the Southern Pacific line in Nevada, but originates in Salt Lake City, Utah, and follows a more northerly route west of Winnemucca. One route to the potential repository (Carlin) would start from the northern Union Pacific line (with an interchange to the Southern Pacific main line).

The southern rail line is the Union Pacific line that runs from Salt Lake City to Barstow, California. The rest of the proposed rail routes (except Ludlow, which initiates on the Santa Fe line in California) to the potential repository use sidings along the Union Pacific line.

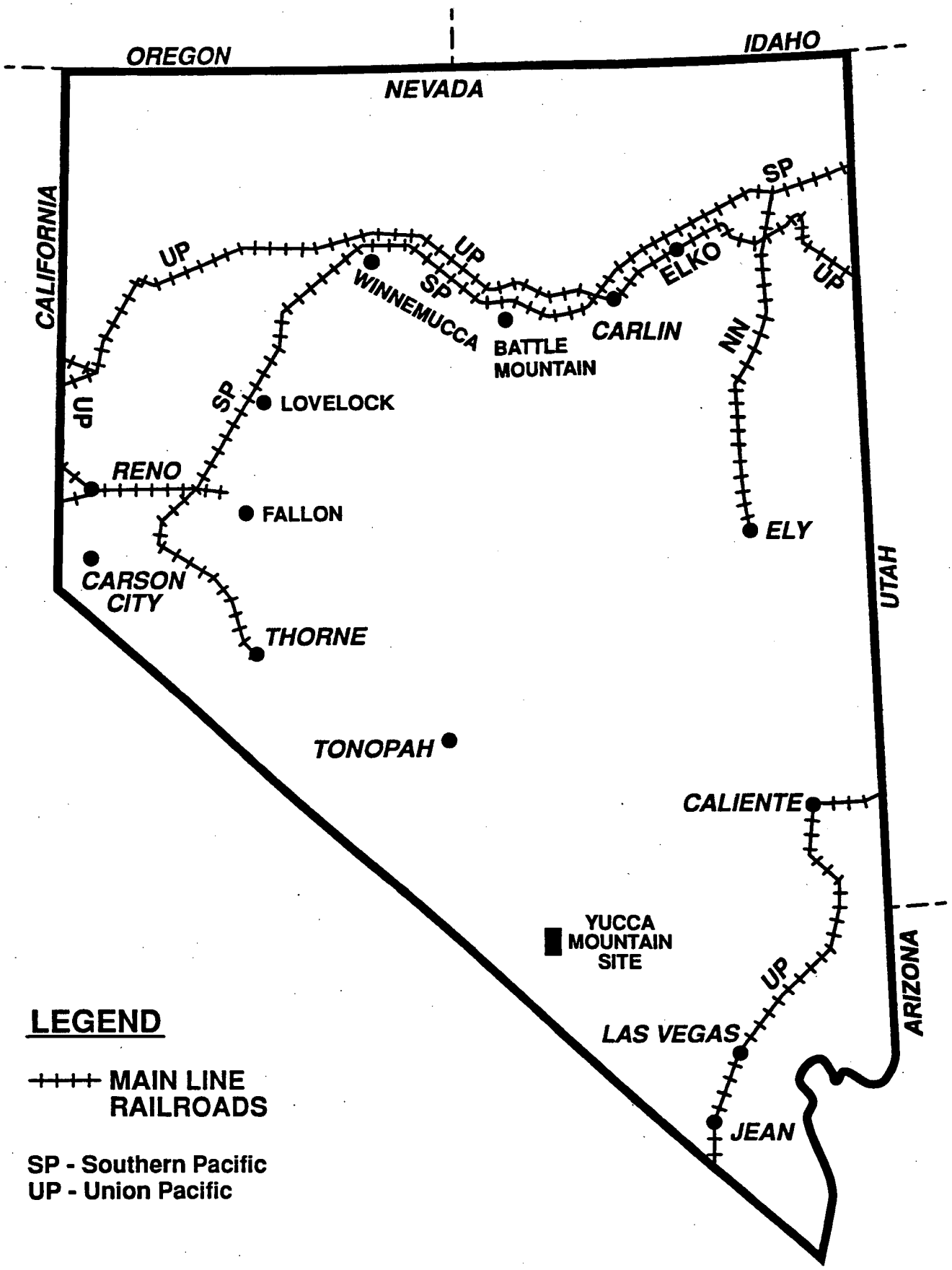


Figure 3-3. Existing Railroads in Nevada

The Union Pacific line runs through the Nevada cities of Caliente and Las Vegas. The line meets the Santa Fe rail line at Barstow. The Union Pacific railroad uses the Santa Fe line as common trackage between Barstow and southern California.

Currently, the National Transportation System group considers all national rail lines to be equally usable for transporting spent nuclear fuel and high-level radioactive waste to Nevada. If a future determination of a preferred national rail routing to Nevada (either the northern route or the southern route) is made, it may affect the rail routing in Nevada. Designation of a preferred national route may further limit the routing options in the state, if review agencies determine that radioactive material shipments will not be routed through Las Vegas.

3.2.2 Alternate Routes Identified in the Preliminary Rail Access Study

The Preliminary Rail Access Study (1990b) identified 13 options for rail access to the potential repository site. The 10 original routes identified by that study team are named for the area where they would connect to the main line railroad. Three additional route options were submitted by Lincoln County and the City of Caliente, and are labeled Options A, B, and C. The routes provide access to the potential repository site through four corridors across the State of Nevada. See Figure 3-4 for a map of the alternative routes within the corridors identified below. (Lincoln County Option C did not provide direct access to the site and was not evaluated by the Preliminary Rail Access Study. It is not shown on Figure 3-4.)

Northern Corridor

The Northern Corridor includes routes that traverse the northern and western sides of the Nellis Air Force Range. Of the 13 routes identified in the Preliminary Rail Access Study (YMP 1990b), four use the Northern Corridor: Mina, Carlin, Cherry Creek, and Caliente. The four routes converge at a point southeast of Tonopah and follow a common route from that point to the potential repository.

Las Vegas Corridor

The Las Vegas Corridor includes routes that traverse the area along U.S. Highway 95 from Las Vegas to the potential repository site. Three of the 13 proposed routes use the Las Vegas Corridor: Dike, Valley, and Arden. The Valley and Arden routes use a common route from a point just north of Nevada State Route 157 to the site. The Valley route crosses U.S. Highway 95 twice; the Arden route crosses U.S. Highway 95 once. The Dike route runs along the north side of U.S. Highway 95 all the way to the site.

Southern Corridor

The Southern Corridor includes routes that converge around the Pahrump, Nevada, area, then traverse the area north of Pahrump, where they cross U.S. Highway 95 to the site. Three of the 13 proposed routes utilize the Southern Corridor: Jean, Crucero, and Ludlow. The Crucero and Ludlow routes originate in California and use a common route for most of their length. The Jean route traverses the Spring Mountains in Nevada, then connects back to the common route near Pahrump.

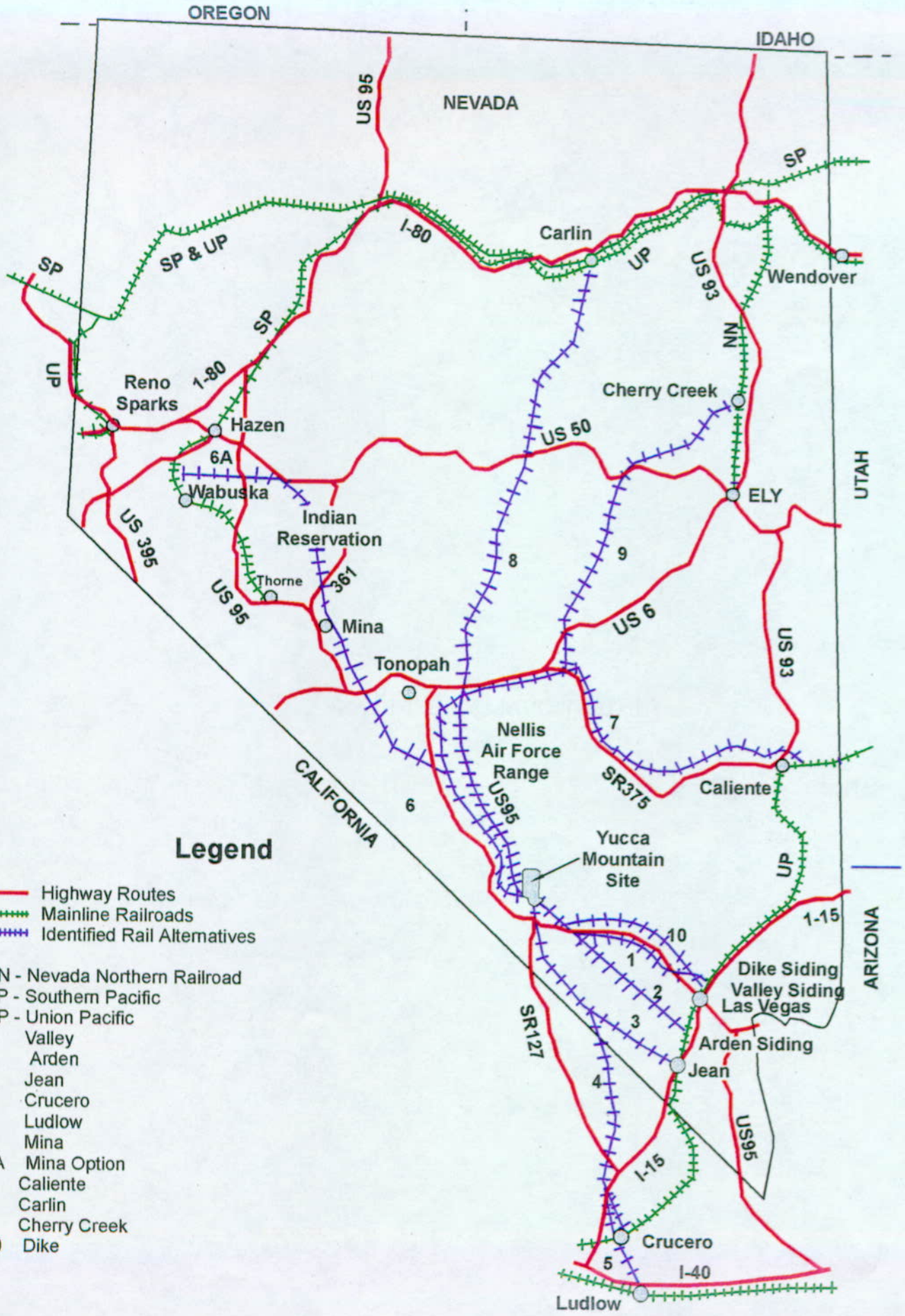


Figure 3-4. Alternate Rail Routes to the Potential Repository Site

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Nellis Air Force Range Corridor

Of the three routes proposed by Lincoln County and the City of Caliente, Nevada, Options A and B originate near the Caliente area, and use a corridor through the Nellis Air Force Range in the Groom Lake area on the northeast corner of the Nevada Test Site.

3.2.3 Rail Alignment Selection Criteria

The criteria developed for evaluating the feasibility of proposed routes in the Preliminary Rail Access Study (YMP 1990b) include areas of known land use incompatibilities, areas of favorable topography, maximized use of Federal lands, providing access to regional carriers, and avoidance of Federally-withdrawn lands from public use. These criteria are described in the following paragraphs. The evaluation of the proposed routes using these criteria is described in Section 3.2.4.

3.2.3.1 Areas of Known Land Use Incompatibilities

The evaluation of land-use conflicts in the Preliminary Rail Access Study (YMP 1990b) was based on information published by the U.S. Department of the Interior, U.S. Bureau of Land Management (BLM). The published information is based on 1984 land-use information including public lands, national forests, national parks and recreation areas, Indian reservations, state lands, patented lode mining claims, U.S. Department of Defense (DOD) and DOE facilities, Federal wildlife refuges, U.S. Bureau of Reclamation land withdrawals, and private lands. Temporary conditions, such as leases, special land use permits, and other land parcels that have not been patented, withdrawn, or segregated from the public domain (such as highway rights-of-way) were not included in the land-use information. The BLM's land-use map for Nevada is shown in Figure 3-5.

The routes selected for evaluation in the Preliminary Rail Access Study use land under public ownership, to the greatest extent possible, to minimize land-use conflicts. The study concluded that, after further evaluation of those routes, known or potential land-use conflicts precluded the reasonable use of 10 of 13 routes (YMP 1990b).

3.2.3.2 Areas of Favorable Topography

The routes selected in the Preliminary Rail Access Study were chosen to use favorable topography within the areas not excluded because of land-use conflicts (YMP 1990b). A maximum allowable grade for a rail alignment has been tentatively established at 2.5 percent (based on the requirement of DOE Order 6430.1A that a maximum grade of 3 percent will not be exceeded for rail); therefore, rugged terrain will require significant earthwork (and rock excavation) to construct a railroad. The routes selected use valleys and mountain range passes to minimize the amount of cut and fill required to maintain a grade not exceeding 2.5 percent. Although feasible from an engineering viewpoint, routes through rugged terrain would be exposed to a higher level of environmental and operational hazards than routes with comparatively gentler terrain.

The most favorable topography occurs along the routes with the most land-use conflicts (Valley, Dike, and Arden). The Las Vegas valley, through which U.S. Highway 95 is routed, provides the least rugged terrain of all the available corridors. The Jean route from the southern portion of the state must traverse the difficult terrain of the Spring Mountains. The routes accessing the potential repository from the north must traverse the rugged terrain to the west of the Nellis Air Force Range.

3.2.3.3 Maximize Use of Federal Lands

As described in Section 3.2.3.1, all routes proposed in the Preliminary Rail Access Study (YMP 1990b) maximize the use of Federal land.

3.2.3.4 Provide Access to Any of Three Regional Carriers

All proposed routes have direct access to at least one major regional carrier, except Mina and Cherry Creek, which initiate on branch lines. The Carlin route has direct access to two rail carriers. The Mina and Cherry Creek routes would have indirect access to two major carriers over branch lines operated by companies other than major carriers.

3.2.3.5 Avoidance of Withdrawn Lands

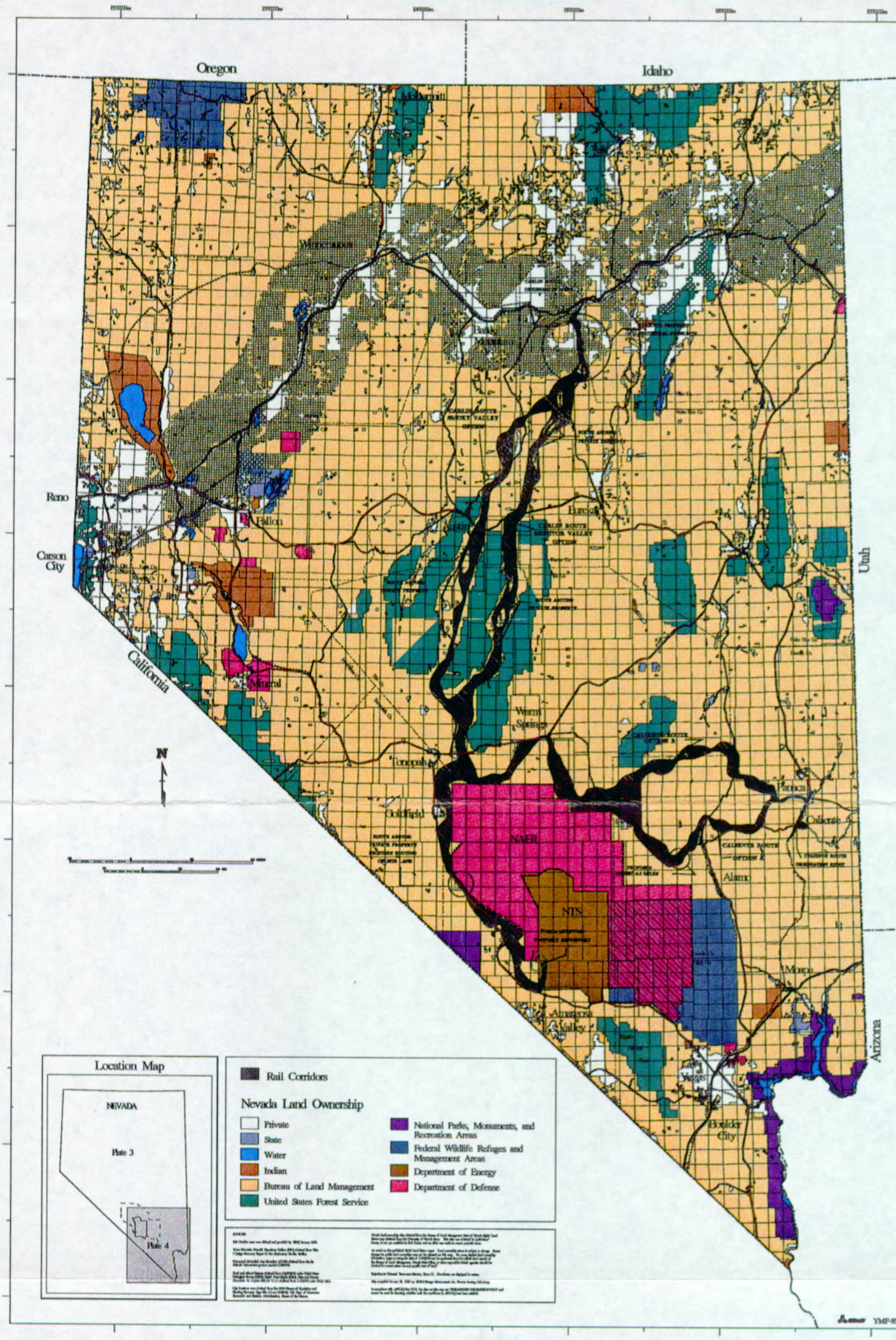
Lands that have been withdrawn from public use by Federal action eliminated the Lincoln County-identified routes A, B, and C and one of the 10 routes proposed by the study team (the Dike route) from being feasible alternatives. A change in status of those areas within the DOD Nellis Air Force Range would allow the Lincoln County optional routes A and B to be included in the list of feasible alternatives and the Dike siding to be used as an initiation point option for the Valley Modified route. Use of this DOD land would require Federal legislation or interagency agreement. Recent direction from DOE stated that rail or heavy haul would violate the integrity and mission of the Nellis Range complex.

3.2.4 Comparison of Identified Routes

An evaluation of the routes identified for each corridor was made in the Preliminary Rail Access Study (YMP 1990b) to determine reasonability of each route when compared to the selection criteria identified in Section 3.2.3. The conclusions are summarized below, and tabulated in Figure 3-6.

Northern Corridor

Mina - This route was found to have significant land-use conflicts with the Walker Lake Indian Reservation. The Walker Indians dispute the ownership of the right-of-way for the branch line from the main line railroad to Mina. The proposed optional route that would not affect reservation land has a potential land-use conflict with the U.S. Naval Bombing Ranges to the east of the reservation. The optional route would traverse very rugged terrain. The study concluded that this route was not a feasible alternative.


Oregon
Idaho
McDermitt
Winnemucca
Battle Mountain
Reno
Fallon
Carson City
Eureka
California
Utah
Arizona
Mineral
Warm Springs
Tonopah
Goldfield
NAFR
NTS
Alamo
Pahrump
Las Vegas
Boulder City
Location Map
NEVADA
Plate 3
Plate 4
Rail Corridors
Nevada Land Ownership
Private
State
Water
Indian
Bureau of Land Management
United States Forest Service
National Parks, Monuments, and Recreation Areas
Federal Wildlife Refuges and Management Areas
Department of Energy
Department of Defense

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MATRIX OF ROUTES VS. EVALUATION CRITERIA

ROUTE	AREAS OF FAVORABLE TOPOGRAPHY	MAXIMIZED USE OF FEDERAL LAND	ACCESS TO > ONE REGIONAL CARRIER	AVOID LAND WITHDRAWN BY FEDERAL ACTION	LAND-USE CONFLICTS	RECOMMENDED FOR ADDITIONAL EVALUATION
CALIENTE ROUTE						
VALLEY ROUTE					Screened Out	A Modified Valley route is being evaluated for feasibility.
JEAN ROUTE						A Modified Jean route is being evaluated for feasibility.
CRUCERO ROUTE					Screened Out	
LUDLOW ROUTE					Screened Out	
MINA ROUTE					Screened Out	
CARLIN ROUTE						
CHERRY CREEK ROUTE					Screened Out	
ARDEN ROUTE					Screened Out	
DIKE SIDING ROUTE				Screened Out		
LINCOLN COUNTY OPTIONS A AND B				Screened Out		
	ROUTES SELECTED FOR EVALUATION WERE BASED ON THESE TWO CRITERIA					

Figure 3-6. Evaluation Criteria Matrix

Carlin - The Carlin route was found to have potential land-use conflicts with private land along a 32-km (20-mile) wide section adjacent to the Southern Pacific main line. The 32-km (20-mile) wide section of land along each side of the main line was granted to the railroad by the Federal Government in the 1860s. Of the 2,023,450 ha (5 million acres) granted to the railroad, ownership of about 607,035 ha (1.5 million acres) (as of 1984) was retained by the railroad; the remainder has been sold to other private owners. The study estimated that land access across approximately 8 km (5 miles) of private property would be required, but proposes that this is considered a minor land-use conflict. The study concluded that the Carlin route should be retained for further evaluation.

Cherry Creek - The Cherry Creek route uses a branch line (Nevada Northern Railroad) currently owned by a private company. Because of the uncertainty of future plans for this branch, the study concludes that the potential conflict makes this route unfeasible. The existing track is also constructed with 60-pound rail which is too light for the proposed MPC loads.

Caliente - The study concluded that the Caliente route had minimal land use conflicts, and should be retained for further evaluation.

Las Vegas Corridor

Dike - The Dike route, as proposed in the study, traverses Nellis Air Force Range land that has been Federally withdrawn from public use. Because of this known land-use conflict, the study concluded that the route was not feasible.

Valley - The study concluded that the Valley route was not feasible due to significant potential land-use conflicts with private land, recreation land and nature area land. Also, the recent expansion of the Red Rock Canyon National Conservation Area creates additional land use conflicts with the proposed Valley route. Figure 3-7 shows current land use conflicts.

Arden - The Arden route was found to have known land-use conflicts with private property development along the west side of Las Vegas, as shown in Figure 3-7. The study concluded this route was not feasible. Population growth in Las Vegas has spurred development in the foothills of the Spring Mountains, closing this corridor as a feasible option.

Southern Corridor

Jean - The study concluded that the Jean route had minor potential land use conflicts, and should be retained for further evaluation.

Crucero - The Crucero route would conflict with existing BLM land-use plans which may not be available if "feasible alternatives" exist. The route also passes in close proximity to areas of critical environmental concern. The study concluded this route was not feasible due to significant potential land-use conflicts. Recent passage of the California Desert Conservation Area Act further restricts use of the proposed route area.

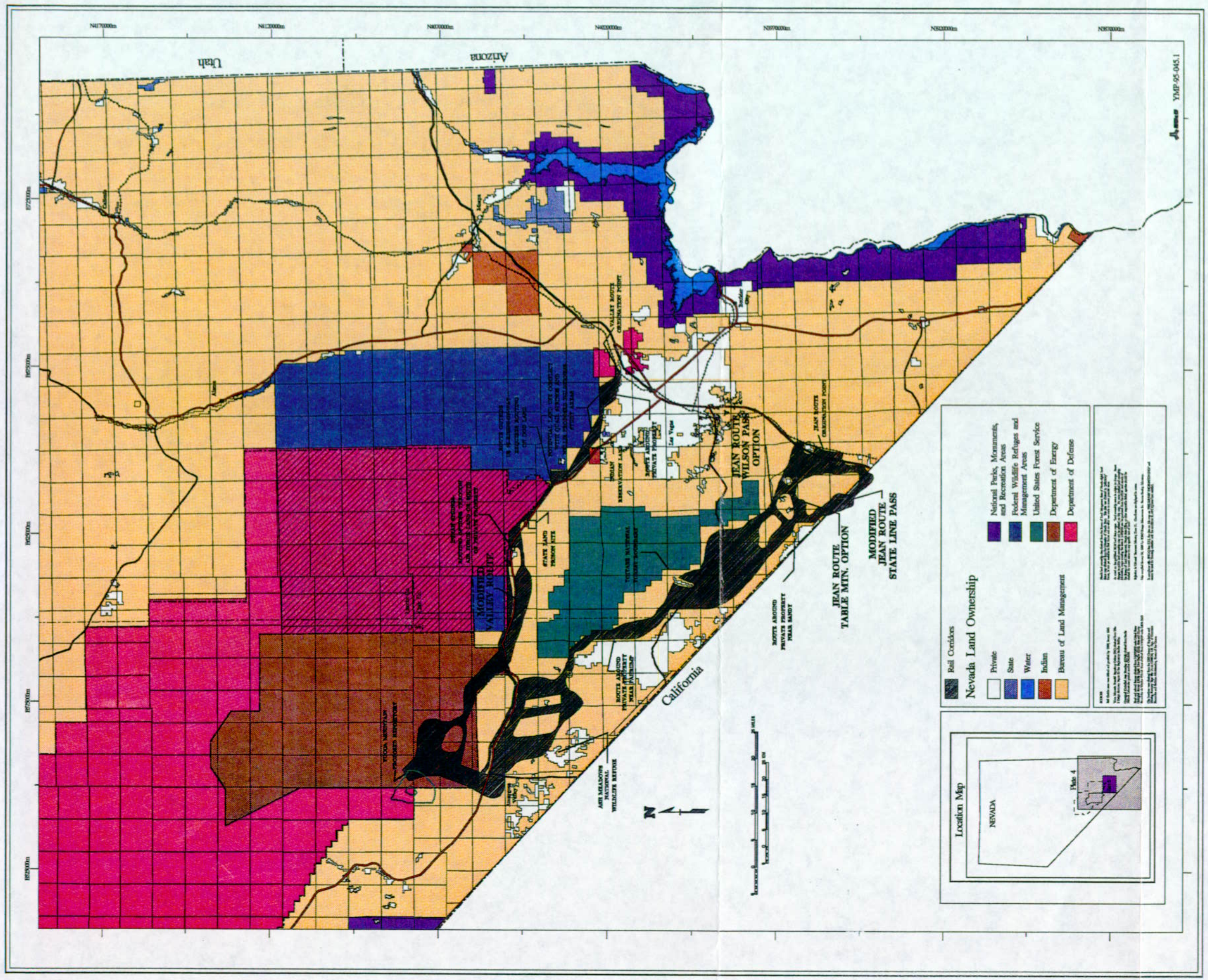

Figure 3-7. Land Use Conflicts with Valley and Arden Routes

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Ludlow - The evaluation of this route was the same as that for the Crucero route. The study concluded the route was not feasible due to significant potential land-use conflicts.

Nellis Air Force Range Corridor

Based on DOE input, this study concluded that the sensitivity of the Nellis Air Force Range has not changed in the past five years (since the Preliminary Rail Access Report was written); therefore, Lincoln County Options A and B (route options through the Groom Lake area) were not feasible. Option C did not provide direct access to the site and was disregarded.

3.2.5 Routes Identified as Reasonable Following Evaluation

The Preliminary Rail Access Study recommended that the Caliente, Carlin, and Jean routes be retained for further evaluation (YMP 1990b). These routes were found to have only minor land-use conflicts. The remaining 10 routes were recommended to be monitored for changes in their status that could improve feasibility.

3.2.6 Route Options Meriting Additional Evaluation

During this study's review of the Preliminary Rail Access Study (YMP 1990b), the determination was made that three additional route options not identified in that study merit further evaluation due to the advantages associated with them. A discussion of those routes follows.

Jean Route Options

An optional routing of the Jean route would originate in the Jean area, cross Interstate 15, and follow a southerly route along the base of the Spring Mountains to a point approximately 1.62 km (1 mile) north of the Nevada-California border. The route would turn west and traverse the end of the Spring Mountains, and traverse the California State Line Pass in a switchback pattern, crossing the northern end of the Clark Mountain Range into Mesquite Valley, California. The State Line Pass area is included as a Wilderness Area in the California Desert Conservation Area. The route would then turn north along the western base of the Spring Mountains, back into Nevada, east of Sandy.

The route would traverse the area east of Pahrump, parallel to State Route 160, and travel north to a crossing over State Route 160. Several options are available for routing the rail line to a crossing point over U.S. Highway 95.

The major advantage of the Jean route State Line Pass option over the original Jean route is that the State Line Pass elevations (maximum elevation in the Pass is 1,097 m/3,610 ft) are much lower than those in the Nevada Wilson Pass (elevation 1,609 m/5,020 ft) and the Table Mountain Pass (elevation 1,341 m/4,400 ft). The State Line Pass also has a much broader, flatter entry area than the Nevada passes, so that switchbacks may be used to maintain a desirable maximum grade of 2.5 percent.

Because the Jean route State Line Pass option is approximately 24.1 km (15 miles) longer than the original Jean route, a cost evaluation must be done to identify whether the costs associated with the increased length are offset by the much more extensive earthwork required on the shorter Nevada route options.

The Jean route State Line Pass option is being retained as a viable option for conceptual design. However, coordination with the responsible California state agencies must be performed to request right-of-way through the established Wilderness Area in the State Line Pass area. According to Richard Fagen of BLM's, Needles, California, office (personal communication, January 10, 1995), obtaining right-of-way through a Wilderness Area is possible, but only if there is no other feasible route.

Valley Modified Route

The original Valley route identified in the Preliminary Rail Access Study (YMP 1990b) was considered not feasible due to possible land use conflicts with two BLM-administered areas (Quail Springs WSA NV-050-411 and Nellis WSA NV-050-4R-15 A, B, and C) that were studied for potential designation as Wilderness Areas. Due to uncertainties of the final land use of these areas (based on recent discussion with BLM Las Vegas District personnel), the Valley Modified route was added to the list of alternatives.

The Valley Modified route is a combination of sections of the proposed Valley and Dike Siding routes identified in the Preliminary Rail Access Study (YMP 1990b). The route would originate near the Valley siding (although potential options to use the Dike or Lovell sidings will be considered) and travel north of the private land, Las Vegas Paiute Indian Reservation land, and north of U.S. Highway 95. The route would continue to Indian Springs, where there are two options available; route the railroad through the Indian Springs Air Force land north of U.S. Highway 95, or cross U.S. Highway 95 and route the railroad through a gap in the hills south of Indian Springs proper. Both options would converge north of U.S. Highway 95 west of Mercury. Two options available from that point on are to follow U.S. Highway 95, and turn north to the potential repository site at the Fortymile Wash, or to follow the route of the existing Jackass Flat Road, west of Mercury, to Jackass Flats.

The proposed Valley route identified in the Preliminary Rail Access Study (YMP 1990b) identified land-use conflicts with private land south of U.S. Highway 95 in the Las Vegas area. The Valley route was proposed south of U.S. Highway 95 to minimize conflicts with the two proposed Wilderness Study Areas north of U.S. Highway 95. The proposed Dike Siding route was identified in the Study as having a land-use conflict with the Air Force land north of the proposed Wilderness Study Areas. The Valley Modified route proposes to route the railroad through the proposed Wilderness Study Areas (WSAs), thus eliminating conflicts with private land or the Air Force land.

The advantages of the Valley Modified route are:

- The route is the shortest proposed rail route to the site, which minimizes cost.

- The route traverses generally gentle terrain; the only areas of rugged terrain are the hilly areas south of Indian Springs, and the Little Skull Mountain area on the Nevada Test Site.

- The Nevada Test Site could use the railroad for freight shipments to the Nevada Test Site and Mercury, and could possibly utilize the railroad for personnel transportation to the Nevada Test Site and Mercury.

The major obstacle to adding the Valley Modified route as a viable alternative to be retained for detailed evaluation is the land-use conflict with the two proposed Wilderness Study Areas. If the route cannot traverse these areas, the extent of private land and Air Force land north and south of the proposed Wilderness Study Areas may eliminate the Valley Modified route as an option.

Carlin Route Option

The Monitor Valley was selected in the Preliminary Rail Access Study (YMP 1990b) as the preferred route for the Carlin route because the number of private land sections was less than other adjacent valleys.

Although the number of private land sections is higher in the Smoky Valley, the option has been added to this discussion because the environmental impacts will probably be lower than those for the Monitor Valley. Land access will be a much greater factor in development of a rail alignment in the Smoky Valley, but in the long run, land access may be less restrictive than resolution of environmental impacts in the Monitor Valley.

3.2.7 Issues Concerning Routes Recommended for Detailed Evaluation

The following paragraphs describe the issues concerning the four routes (plus route options) identified to this point as reasonable and recommended for detailed evaluation. The concerns will be addressed by beginning at the origination point of each route and identifying potential problems along the route.

Caliente

The Caliente route has been conceptually designed with two major routing options. Option A traverses much more rugged terrain, and requires a tunnel at one point along the route. Option B traverses an area of much gentler grades in the area between Caliente and the northeast corner of the Nellis Air Force Range. The proposed Caliente route limits are shown on Figure 3-5. This discussion will focus on the Option B route as the preferred option. The route concerns include:

A. Private property around the Caliente area causes potential land-use conflicts.

B. Rugged terrain west of Caliente requires significant earth and rock work.

C. Drainage structures are required in the Dry Lake Valley area and across the White River. Also, a grade separation over Nevada State Route 318 is required in the White River crossing area.

D. The route passes through a low area of the Golden Gate Range into Garden Valley. There are several large tracts of private land in the pass area into Garden Valley that may have the potential for land-use conflicts.

E. The route crosses a secondary road north of the Worthington Mountains. Evaluation must be made to determine if a grade separation is required.

F. A grade separation over Nevada State Route 375 is required west of the Quinn Canyon Range.

G. The route crosses a secondary road in the Reveille Valley. An evaluation must be made to determine whether a grade separation is required.

H. The Kawich Range north of the Nellis Air Force range will require the railroad to be routed to the north end of the range adjacent to U.S. Highway 6 near Warm Springs. There is a potential conflict with U.S. Highway 6 right-of-way.

I. The route crosses a secondary road in Cactus Flats. An evaluation must be made to determine whether a grade separation is required.

J. The area around Goldfield Hills is heavily congested with patented mining claims between U.S. Highway 95 and the Nellis Air Force range. Land access will be more difficult in this area, and interagency agreements to route the railroad on DOD land may have to be evaluated.

K. The area along the west side of the Nellis Air Force Range is very rugged, and will require significant earth and rock work to provide a 2.5 percent maximum grade.

L. The Scotty's Junction area on the west side of the Nellis Air Force range contains private land that extends from U.S. Highway 95 to the Air Force range. Options include building the route on Air Force range land in this area, acquiring land access to private land, or passing west of Scotty's Junction over U.S. Highway 95, Nevada State Route 287, and then back over U.S. Highway 95 via three grade separations.

M. Private land and patented mining claims north of Beatty adjacent to the Nellis Air Force range will restrict routing, and may produce potential land-use conflicts.

N. Rugged terrain from the Beatty area to the south end of Yucca Mountain will require significant earthwork and rock excavation to provide a 2.5 percent maximum grade.

O. The Caliente route is 587.3 km (365 miles) long, and would require multiple design and construction teams working concurrently to design and build the railroad within the same schedule requirements that would be established for a shorter route. Construction work, performed concurrently at many fronts, will increase costs and will require extensive construction management support.

P. The regulation 40 CFR 228 limits train crew duty to a maximum of 12 consecutive hours; this may require a crew change be performed for the Caliente Route because of its length.

Carlin

The Carlin route has two major routing options: the Monitor Valley or the Smoky Valley for access to the Cactus Flats area. The proposed Carlin route limits are shown on Figure 3-5. The concerns for designing and constructing a railroad through either of these valleys are discussed below.

A. The origination point of the Carlin route is on the main line railroad west of Carlin. The first 32 km (20 miles) of the route must traverse privately-owned land, either by the railroad or other private parties who bought the land from the railroad. A detailed evaluation of the ownership of this land must be made to identify which portions are still owned by the railroad, and which portions have been sold. It may be easier to obtain land access through this area if the route could be designed to cross only railroad-owned land. Land access will be a critical design criteria for the Carlin route, as the origination point and routing through the first 32 km (20 miles) will significantly impact the rest of the route selection.

B. Numerous isolated sections of private land must be routed around in Monitor Valley, Grass Valley, and Smoky Valley, depending on the route selected.

C. Grade separations will be required at Nevada State Route 278, U.S. 50 and Nevada State Route 376 if the Smoky Valley option is selected.

D. If the Monitor Valley option is selected, a secondary state road through Monitor Valley must be evaluated to determine if a grade separation is required.

E. The Monitor Valley was selected in the Preliminary Rail Access Study (YMP 1990b) as the preferred Carlin route because the number of private land sections was less than adjacent valleys. However, evaluation of the environmental impacts in the Monitor Valley may conclude that a Smoky Valley route may have lower impact.

F. Although the number of private land sections is higher in the Smoky Valley, the option has been added to this discussion because the environmental impacts will probably be lower than those for the Monitor Valley. Land access will be a much greater factor in development of a rail alignment in the Smoky Valley, but

in the long run, land access may be less restrictive than resolution of environmental impacts in the Monitor Valley.

G. Either valley route option will require a grade separation over U.S. Highway 6 east of Tonopah.

H. The Carlin route (either valley option) would follow the same route as that described for the Caliente route, west of the Nellis Air Force range. See Items J through O in the Caliente route discussion.

I. The regulation 40 CFR 228 limits train crew duty to a maximum of 12 hours; this may require a crew change be performed for the Carlin Route because of its length (571.2 to 587.3 km/355 to 365 miles, depending on the route option selected).

Jean

The Jean route originates on the Union Pacific main line either north or south of the private land around Jean. The proposed Jean route limits are shown on Figure 3-8. Several route options through the Spring Mountains and around the Pahrump area are available. The concerns for designing and constructing a railroad through these areas are discussed below.

A. The route must cross Interstate 15 (via grade separation) before traversing the land east of the Spring Mountains. Two options are currently considered feasible for the traverse of the Spring Mountains in Nevada: the Wilson Pass area northwest of Goodsprings, and the Table Mountain pass southwest of Goodsprings. A third option through the California State Line Pass area is also recommended for further consideration.

B. For the two Spring Mountain Pass options, the route would parallel Nevada State Route 161 to Goodsprings, then would switchback up the east side of the Spring Mountains to one of the pass areas identified. Evaluation of switchbacks versus tunneling (or a combination of the two) would be performed for either of the route options. The alignment of the existing roads over the passes may have to be changed to accommodate the railroad, due to limited space within the higher elevations of the passes. The existing roads would be rerouted to run parallel with the railroad through the passes. Either pass route will require land access to numerous patented mining claims throughout the Spring Mountain area.

C. The California State Line Pass option origination point would be south of the Jean area, between Jean and Borax. The route would travel along the east side of the Spring Mountains to the State Line Pass. A patented mining claim in the Spring Mountain area north of the state line would require land access agreements to be negotiated. The route must pass through the mining claim area to eliminate land-use conflicts with the private land along Interstate 15 at the state line. Rugged terrain precludes establishing the route any further north. The route would require switchbacks across State Line Pass, California, requiring that

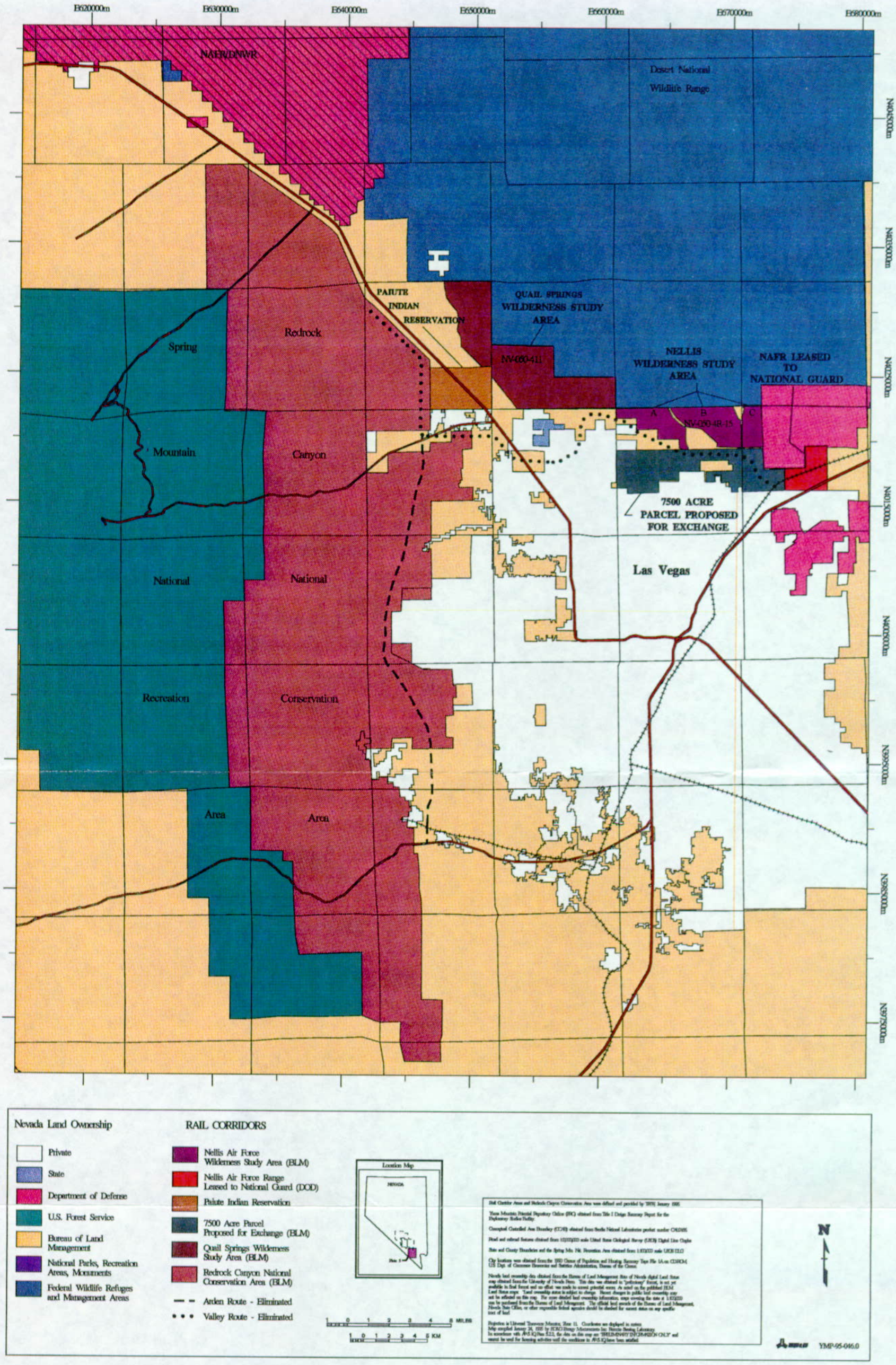

Figure 3-8. Proposed Jean and Valley Modified Route Limits

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the existing road through the pass be realigned to minimize intersections with the railroad. The route must pass through the State Line Pass Wilderness Area of California, which will require a right-of-way from BLM for the use of the land.

D. The route (either of the three pass options) would skirt around the east side of the private land in Sandy Valley.

E. The route option identified in the Preliminary Rail Access Study (YMP 1990b) would pass southwest of the town of Pahrump. Toward the north end of the Pahrump Valley the rail line would cross Nevada Highway 372 via a grade separation. At the end of Pahrump Valley, the route option would cross through a ridge of hills into the Stewart Valley dry lake. The rail line would continue northwesterly for approximately 25.7 km (16 miles) before turning north toward the site. The route option would pass within 3.2 km (2 miles) of the Ash Meadows community. This option is not delineated on Figure 3-8.

F. A second route option (shown in Figure 3-8) would require a grade separation over Nevada State Route 160 between the Sandy Valley area and Pahrump. An evaluation would be made to determine if a grade separation would be required over the secondary road along Lovell Wash. Another secondary road evaluation would be required for the road along Wheeler Wash, northeast of Pahrump. The route would skirt the east side of the private land around Pahrump, adjacent to the boundary of the Toiyabe National Forest. East of Mt. Montgomery, the route would cross Nevada State Route 160 via a grade separation, then take a switchback route down the grade to the flats north of the Ash Meadows National Wildlife Refuge.

G. Isolated sections of private land on the flats north of the Ash Meadows Wildlife Refuge must be skirted on either route option, with the route crossing U.S. Highway 95 at a point between Nevada State Routes 160 and 373.

H. The route would then generally parallel U.S. Highway 95 to the Fortymile Wash, where the route would turn north to the site traversing the area east of Yucca Mountain. A major drainage structure would be required at the Fortymile Wash crossing.

Valley Modified

The Valley Modified route originates at a point between the Valley siding and Dike siding. Until the route reaches Indian Springs, numerous land-use conflict points must be evaluated and resolved. The proposed Valley Modified route limits are shown on Figure 3-8.

A. The area west of the Valley siding allows only a narrow corridor between the Nellis Air Force range to the north and private land to the south. The route passes under the transmission lines approximately 1.62 km (1 mile) west of the Valley siding.

B. The route must traverse the area north of the Floyd Lamb State Park and Las Vegas Paiute Indian Reservation land along U.S. Highway 95 (approximately 24.1 km/15 miles west of the Valley siding). The land through which the route must travel is currently under evaluation for two proposed Wilderness Areas.A traditional lifeway area (an area considered by Native Americans to exhibit values necessary for the continuation of cultural rules of practice) has also been proposed for the area between the Indian reservation and the wildlife refuge.

C. The route must then traverse a very narrow corridor between Nellis Air Force Range land and the U.S. Highway 95 right-of-way. The route may have to be established on a portion of the Nellis Air Force Range land.

D. The route must pass through the Indian Springs Air Force Auxiliary Field area, or cross U.S. Highway 95 via a grade separation, and traverse the low hills south of Indian Springs. If a route south of Indian Springs is selected, the route must cross U.S. Highway 95 north of the state land where the prison is located. The existing grades in the pass through the low hills south of Indian Springs would not require significant earthwork to establish a 2.5 percent grade. The existing road through the hills would require realignment to parallel the railroad.

E. If the route is selected south of U.S. Highway 95, another grade separation would be required over U.S. Highway 95 west of Mercury. If the north option is selected, the roads to Mercury would require evaluation to determine if grade separations were required.

F. The route options from the point west of Mercury to the potential repository site include: (1) a route parallel to U.S. Highway 95 to the Fortymile Wash area, which would require significant earthwork and rock excavation in the Point of Rocks area and a major drainage structure over the Fortymile Wash; or (2) a route along the existing Jackass Flats Road west of Mercury to Jackass Flats, over the pass between Skull Mountain and Little Skull Mountain or around the south end of Little Skull Mountain. This route option will also require a major drainage structure over Fortymile Wash.

3.2.8 Cost Comparison of Potential Routes

A preliminary cost estimate for each of the routes (including options) recommended for detailed evaluation in Section 3.2.7 has been developed. The preliminary cost estimate was developed by using the detailed cost estimate for the two Caliente route Options A and B in the Caliente Conceptual Design Report (SAIC 1992) and grouping the cost estimate line items into unit costs that could be used to apply to identifiable quantities for the remainder of the routes.

The quantities that could be reasonably identified for the routes which have been recommended for detailed evaluation, based on preliminary routing information, are:

- Total mileage.

- Percentage of total route mileage in which the alignment must traverse areas where the existing topography grade is:

  - 0 percent to 3 percent
  - 3 percent to 6 percent
  - Greater than 6 percent.

- Number of grade separations.

- Number of drainage structures.

- Tunnel requirements and estimated length.

- Land access costs, based on the amount of potential land-use conflicts. Land access cost was added as a multiplier to the railroad construction costs: a multiplier of 1.02 for rural BLM land, 1.04 for sparsely-grouped private land within the route boundaries, and 1.10 for urban and more tightly-grouped private land within the route boundary

The total cost for each of the routes was calculated based on the Caliente unit costs for those items delineated. The cost estimates are shown in Figure 3-9. These cost estimates are not directly comparable to the capital cost estimates included in the Preliminary Rail Access Study (YMP 1990b). The Preliminary Rail Access Study did not include contingency and engineering costs in the capital costs. Also, the basis for the rough unit costs developed in the Preliminary Rail Access Study for flat to rolling terrain, mountainous terrain, and rugged mountainous terrain were superseded by estimates included in the Caliente Conceptual Design Report (SAIC 1992). The Caliente Conceptual Design Report cost estimates were calculated by estimating individual activity quantities (e.g., earthwork), and applying unit costs that are much more well established (Nevada Department of Transportation published construction unit costs) than the simple cost per mile assumptions used in the Preliminary Rail Access Study.

3.3 HEAVY-HAUL TRUCK

This discussion on the feasibility of heavy hauls of 68.0-tonne (75-ton), 113.4-tonne (125-ton), and the 104.0-tonne (114.6-ton) high-level waste casks by truck within Nevada is based on weight and length considerations of the load. The feasibility of truck transport of radioactive material as the commodity of the heavy haul will be evaluated in the EIS process.

3.3.1 State Permit Requirements

The discussion concerning state-designated routes for transport of radioactive material is included in Section 3.1.

Permits are issued by Nevada Department of Transportation on a single shipment basis for truck shipments over 58,514 kg (129,000 pounds) GVW. A multiple shipment permit issuance is possible for limited similar shipments (in accordance with Nevada Administrative

Codes 484.500 through 484.580). The state would require pilot vehicles to accompany the transporter. Flagmen may be required at intersections determined by the Nevada Department of Transportation to require traffic control.

The State of Nevada restricts loads on highways during certain times of the year because of moisture in the road base that may cause road damage. These restrictions will impact heavy hauls in the spring (February 7 through April 29) to legal axle and tandem axle weights in accordance with Nevada Department of Transportation Restricted Overweight Travel Routes, issued February 1994. Susan Peterson, Nevada Department of Transportation, confirmed that usage is restricted on the following routes (identified as potential heavy-haul routes) during the restriction period: Nevada State Route 375 from Hiko to U.S. Highway 6; U.S. Highway 6 from Tonopah to Lockes; U.S. Highway 95 from Tonopah to Goldfield; and Nevada State Route 317 from Caliente to Elgin (personal communication, January 24, 1995). The restricted overweight travel routes are shown in Figure 3-10.

The time it takes to have a heavy-haul permit reviewed and approved by the State of Nevada is from one week to one month depending on the load, the route, the time of year, and the U.S. Department of Transportation backlog.

3.3.2 Heavy-Haul Tractor/Trailer Equipment Requirements

Overweight trucks would be required to meet the state requirements for maximum axle loads (9,072 kg [20,000 pounds] for a single axle and 15,422 kg [34,000 pounds] for a tandem axle) and minimum axle spacings. The heavy-haul trucks required to transport 113.4-tonne (125-ton) casks would have approximately 13 axles (See Figure 2-7), configured to meet the state's axle load limits for roads which the Nevada Department of Transportation has designated for over legal weight loads in two axle load categories (colored green and purple in Figure 3-11). Purple routes are designated for the highest allowable axle loading, and green routes allow slightly lower axle load limits. The 13-axle trailer would be approximately 45.1 m (148 ft) long. A push tractor may be required to assist the standard over-the-road tractor, or a higher horsepower, heavy duty tractor could be used, depending on the road grades and transport distances to be negotiated. Equipment can obtain speeds from 16.1 km to 80.4 km (10 to 50 miles) per hour, depending on the road grade, road condition, and operating conditions (weather). The Nevada Department of Transportation will restrict transporter speeds based on those criteria.

The equipment can operate effectively on either asphalt or concrete surfacing; there is little difference in transporter operation. Operation of equipment on unpaved roads is not recommended, although if the unpaved roads are properly constructed, they could be used. Stability inspections of the road surface would be made on a shipment-by-shipment basis.

3.3.3 Grade Restrictions

Road grade should be limited to a maximum of four to five percent. Grades of six to seven percent could be negotiated, but may require additional tractors, and may require larger tractors (other than standard over-the-road tractors). Road camber should be limited to three to four percent.

(All Totaled Costs Rounded to Nearest $100,000)

GRADES LISTED SHOW GRADE OF EXISTING GROUND							(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
(2) TOTAL MILEAGE	(3) MILEAGE @ 0-3% GRADE	(4) COST/MILE [1] @ 0-3%	(5) MILEAGE @ 3-6% GRADE	(6) COST/MILE[1] @ 3-6%	(7) MILEAGE @ > 6% GRADE	(8) COST/MILE[1] @ > 6%	TUNNEL COST	SUB-TOTAL	NO. OF GRADE SEPARATIONS	COST/EACH SEPARATION[4]	SUB-TOTAL GRADE SEPARATION	# OF DRAIN STRUCTURES	COST/EACH STRUCTURE	SUB-TOTAL DRAIN STR	TOTAL DIRECT COST	CONTIN-GENCY @ 35% OF D.C.	ENGINEER-ING COST @ 24%	TOTAL COST[3] (1990 $)	TOTAL COST[3] (1994 $)
365	185	$1,224,000	152	$2,244,000	28	$3,640,000	$60,000,000	$730,300,00	4	$500,000	$2,000,000	34	$1,224,583[2]	$44,100,000	$776,400,000	$271,800,000	$251,600,000	$1,299,700,000	$1,437,500,000
355	262	$1,224,000	83	$2,244,000	10	$3,570,000		$542,600,000	5	$500,000	$2,500,000	36	$1,282,917[2]	$46,200,000	$591,300,000	$206,900,.000	$191,500,000	$989,900,000	$1,094,800,000
350	280	$1,248,000	61	$2,288,000	9	$3,640,000		$521,800,000	4	$500,000	$2,000,000	57	$1,282,917	$73,100,000	$596,900,000	$208,900,000	$193,400,000	$999,200,000	$1,105,100,000
365	285	$1,248,000	71	$2,288,000	9	$3,640,000		$551,200,000	6	$500,000	$3,000,000	63	$1,282,917	$80,800,000	$635,000,000	$222,300,000	$205,700,000	$1,063,000,000	$1,175,700,000
103	88	$1,320,000	11	$2,420,000	4	$3,850,000		$158,200,000	2	$1,500,000	$3,000,000	24	$1,282,917	$30,800,000	$192,000,000	$67,200,000	$62,200,000	$321,400,000	$355,400,000
121	85	$1,320,000	27	$2,288,000	9	$3,640,000		$207,000,000	4	$750,000	$3,000,000	35	$1,282,917	$44,900,000	$254,900,000	$89,200,000	$82,600,000	$426,800,000	$472,000,000
116	81	$1,320,000	26	$2,288,000	9	$3,640,000		$199,000,000	4	$750,000	$3,000,000	35	$1,282,917	$44,900,000	$246,900,000	$86,400,000	$80,000,000	$413,300,000	$457,100,000
127	99	$1,248,000	24	$2,288,000	4	$3,570,000		$192,700,000	4	$750,000	$3,000,000	32	$1,282,917	$41,000,000	$236,700,000	$82,900,000	$76,700,000	$396,300,000	$438,300,000

t costs were established at:

e $,1,200,000
e $2,200,000
: $3,500,000

ack and signal costs, including the identified major cost drivers of earth
st, and track and ties. The other major cost drivers - grade separations and
own as separate cost items in columns 11 through 16.

er was applied to the unit costs listed, based on the amount of potential land-
of 1.02 was applied for rural Bureau of Land Management land, a multiplier
rsely grouped private land within route boundaries, and a multiplier of 1.10
more tightly grouped private land.

E UNIT OST	MULTIPLIER		
	1.02	1.04	1.10
00,000	1,224,000	1,248,000	1,320,000
00,000	2,244,000	2,288,000	2,420,000
00,000	3,570,000	3,640,000	3,850,000

[2]Estimated average unit cost from the Caliente Conceptual Design Report. The higher of the unit costs from the two route options was used for the other route estimates ($1,282,917).

[3]The total cost in 1990 $ (column 20) has been included to shown comparison to the total costs identified in the Caliente Conceptual Design Report, which was based on 1990 $. The escalated total cost in column 21 shows the 1990 $ total cost escalated by a factor of 1.106 to 1994 $.

[4]Based on the Caliente Conceptual Design Report estimate, average unit costs were estimated for grade separations at:

$1,500,000 for major structures
$500,000 for minor structures

The cost/each separation shown is a result of the combination of major and minor separation unit costs for each route. The 3 Jean Route options include 1 major separation and 3 minor separations for an average unit cost of $750,000/separation.

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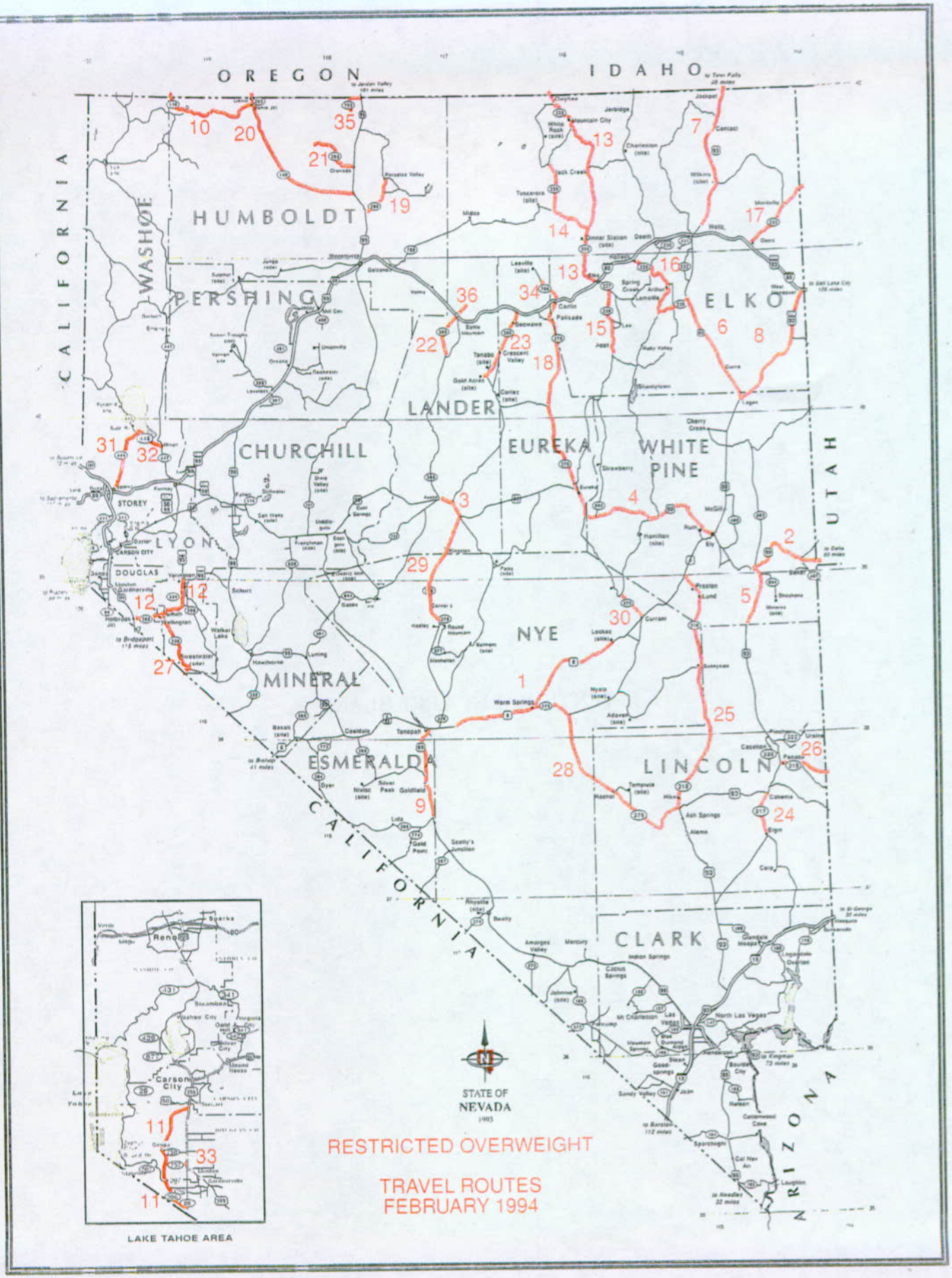

Figure 3-10. Restricted Overweight Travel Routes

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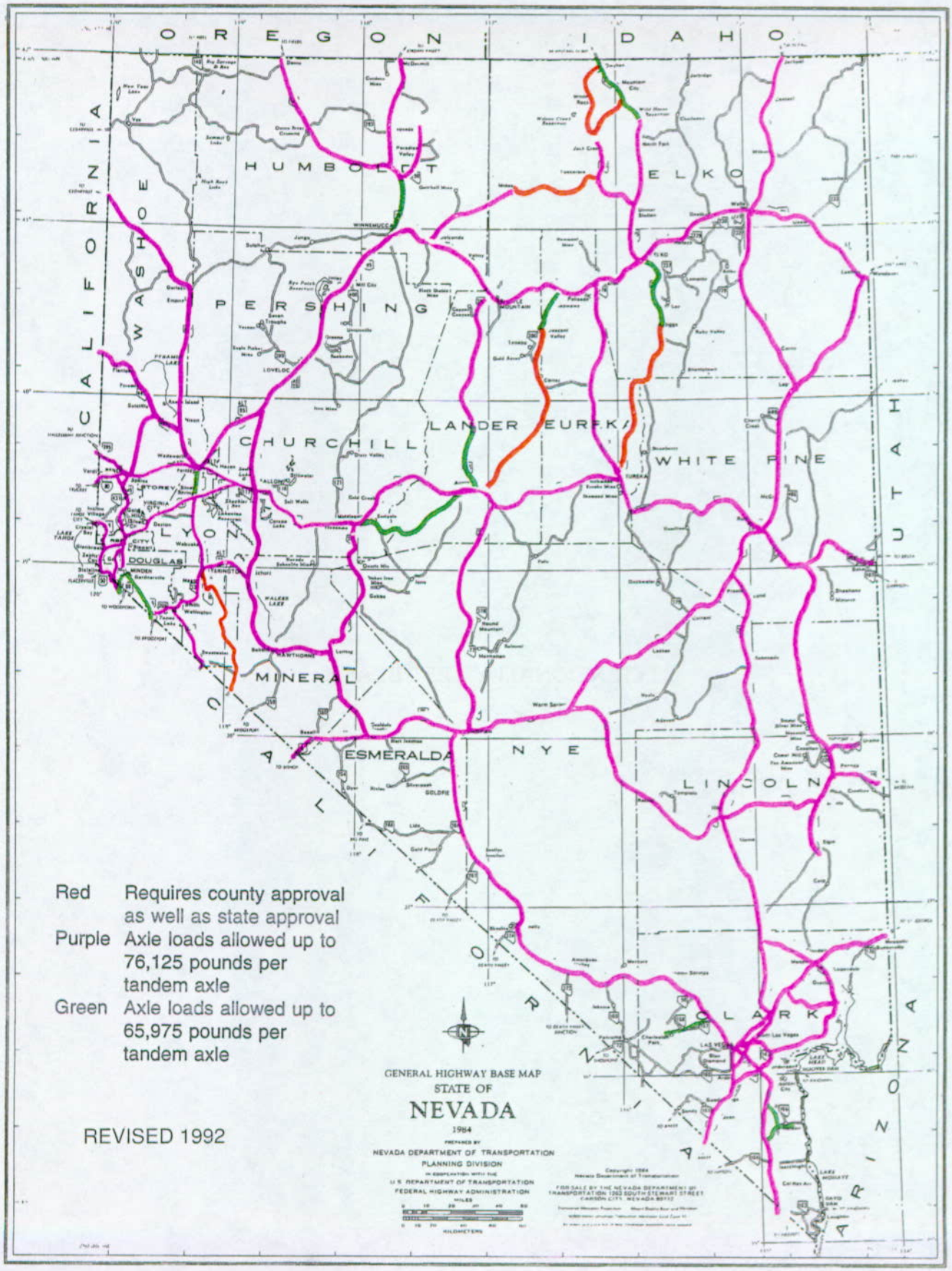

Figure 3-11. Road Load Limits Map

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3.3.4 Cost

The estimated transport cost for a single round trip haul would be $20,000 to $25,000 from the Las Vegas area along U.S. Highway 95 to the site. Multiple hauls would reduce the per-haul costs by eliminating mobilization and demobilization costs for equipment and personnel and by providing dedicated equipment configured to the loads. The reduced per-haul cost would be in the $10,000 to $15,000 range. This cost does not include permit costs paid to the state; an annual fee of $29,120 based on a rate of seven shipments per week would be imposed. (Data confirmed with Nevada Department of Transportation permit section on January 30, 1995.) An added cost is an annual $1,000 hazardous materials permit for carriers with 6 to 25 vehicles.

Operation and maintenance costs for heavy-haul over a 24-year waste emplacement period, based on the preliminary cost information above, were calculated on an estimated 468 waste shipments per year average (11,230 total trips), for an estimated cost of $171 million to $173 million, depending on the route used. The cost estimate includes the cost for construction and operation of an intermodal transfer facility (see Section 5.3.1 for a description of the facility) at the rail main line, to transfer waste casks from rail to heavy-haul truck. The pre-conceptual estimate for construction of the facility is $2.6 million, and the operation costs are included in the heavy-haul truck operation costs.

The life-cycle cost for the heavy-haul option is approximately 50 percent of the lowest rail construction cost estimate because the heavy-haul options use existing roads, thus requiring minimal capital costs to be expended to start transport operations. Because the heavy-haul option is significantly less expensive than any rail option, heavy-haul will be maintained as a reasonable transportation alternate and is recommended for further evaluation.

3.3.5 Travel Restrictions

The transport of the MPC and high-level waste casks to Nevada from the generators will be by rail. The casks would then be transferred from rail car to heavy-haul trucks at the siding selected in the preferred alternative for the truck haul road routing. The use of heavy-haul trucks for transporting the casks will be limited to roads from the siding to the site. Currently, the roads proposed for heavy-haul transport (see Figure 3-12) include:

- U.S. Highway 93 from Caliente to Hiko
- Interstate 15
- U.S. Highway 95 from Interstate 15 to Tonopah
- Nevada State Route 160 from Interstate 15 to U.S. Highway 95
- U.S. Highway 93 from Hiko to Interstate 15
- Nevada State Route 375 from U.S. Highway 93 to U.S. Highway 6
- U.S. Highway 6 to U.S. Highway 95
- Kane Springs Road from Elgin to U.S. Highway 93.

Existing rail sidings (Jean, Arden, Valley, and Dike) could be used to directly access the proposed heavy-haul roads.

Of the proposed heavy-haul roads listed, the following roads are not on the Nevada Department of Transportation list of proposed routes for transport of radioactive materials. These roads would have to be added to allow use of these sidings.

- Elgin — Kane Springs Road from Elgin to U.S. Highway 93. This road currently has a dirt/gravel surface and would require upgrading to a paved surface.
- Caliente — The section of U.S. Highway 93 from Caliente to Hiko.

3.4 TRUCK VERSUS RAIL SAFETY ISSUES

Between 1974 and 1989 there were 12,954 commercial truck accidents in Nevada (YMP 1991c). Urban accident rates in Nevada for trucks on primary roads in 1988 were 987 accidents per 161 million km (100 million miles). Rural accident rates in Nevada for trucks on primary roads in 1988 were 210 accidents per 161 million km (100 million miles). Between 1979 and 1988 there were 208 rail accidents (including derailments) in Nevada (YMP 1991b). Accident rates in Nevada for all trains from 1984 to 1988 were 201 accidents per 161 million km (100 million miles). It is estimated that 34 percent of the train accidents are at rail-highway grade crossings; use of grade separation at road intersections would significantly reduce the accident rate.

Association of American Railroads research shows that railroads are five times safer than trucks in terms of accidents per ton-mile when carrying hazardous materials (1993). Trucks had almost five accidents per billion ton-miles for every one railroad accident or derailment while carrying hazardous materials. In 1991 railroads generated 65.9 billion hazardous cargo ton-miles on movements greater than 322 km (200 miles), but had only 65 accidents or derailments involving a release of hazardous material.

Railroads ensure that the shipment is separated from other traffic and the public in general; trucks travel with other vehicles on the roadways, and are more integrated in public areas. Truck transport will require contingency plans for weather problems; rail transport is not as severely affected by bad weather. The percentage of accidents in bad weather to total accidents is similar for trucks and railroads; however, rail transport can be performed in weather that will not allow trucks to operate. Also, the state Department of Transportation will restrict heavy-haul truck travel in bad weather.

3.5 HEAVY-HAUL ISSUES

The following issues associated with the use of heavy-haul transportation must be taken into account in the review of truck transport of the MPC and high-level waste casks:

- The routes restricted by the Nevada Department of Transportation during periods of possible road damage from moisture and freezing—U.S. Highway 6, Nevada State Route 375, and a portion of U.S Highway 95 (see Figure 3-9)—may require that heavy-haul transport be routed on U.S. Highway 93 and U.S. Highway 95 during February through April.

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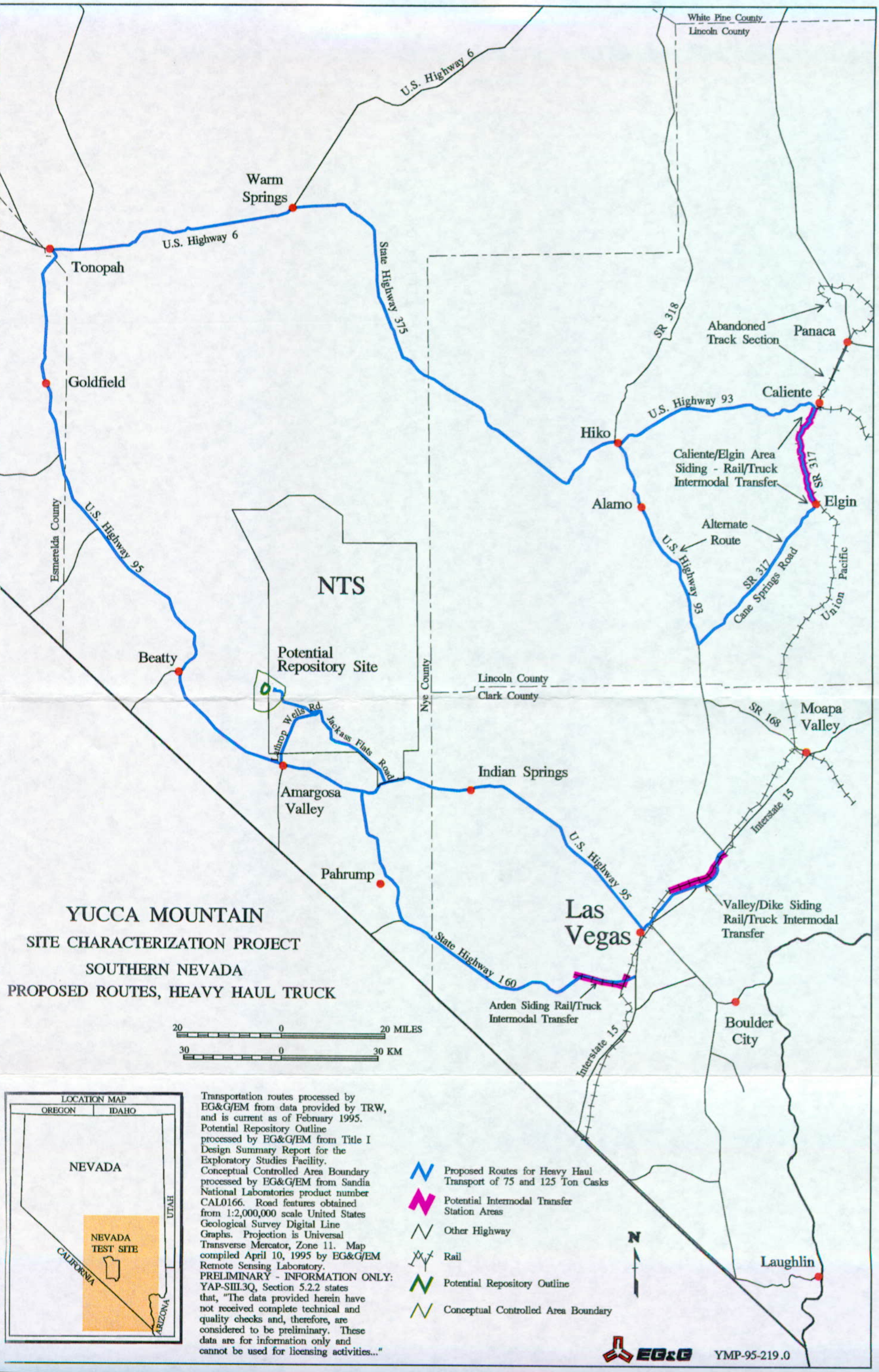
YUCCA MOUNTAIN
SITE CHARACTERIZATION PROJECT
SOUTHERN NEVADA
PROPOSED ROUTES, HEAVY HAUL TRUCK

Figure 3-12. Heavy-Haul Routes



April 1995

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- Nevada State Route 160 is restricted to loads under 2.6 m (8 ft, 6 in) wide unless there is no other route available. All of the transportation casks are wider than 2.6 m (8 ft, 6 in). This road is currently scheduled for upgrade, and width restrictions may be lifted following completion of that work.

- Institutional concerns for transport through heavily populated areas (such as Las Vegas and Tonopah) must be addressed.

- The possibility of local ordinances that restrict heavy-haul traffic must be addressed.

- Temporary restrictions on the available routes (such as road construction and weather problems) may cause shipment delays, requiring some temporary staging area requirements at the intermodal transfer point.

- Heavy-haul is permitted Monday through Friday only in daylight hours (excluding holidays).

- Further restrictions will be imposed by the Nevada Department of Transportation because of the nature of the shipment. The Nevada Department of Transportation regulation that addresses radioactive shipments is based on 49 CFR 397.101 through 103. Factors affecting restrictions for radioactive material shipments include route length, population density, traffic count, and historical data on accident rates.

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4. TRANSPORTATION SYSTEM APPROVAL PROCESS

4.1 STATE-DESIGNATED HIGHWAY ROUTE REQUIREMENTS

As discussed in Section 2.1.3, the state has the authority under DOT regulations (49 CFR 397 Subpart D) to designate preferred alternative highway routes for highway route controlled quantity of radioactive materials. The current schedule for truck shipments to Yucca Mountain, should that site be found suitable and licensed by the NRC, is not before 2010; therefore, it is premature to identify preferred alternative routes at this time. Should the state identify preferred options, DOE will be required to use them.

4.2 NATIONAL ENVIRONMENTAL POLICY ACT PROCESS

The OCRWM is charged with developing the nation's first repository for the permanent storage of spent nuclear fuel and high-level radioactive waste. The Nuclear Waste Policy Act of 1982, as amended (NWPA), directs DOE to characterize only one site, Yucca Mountain, for the first repository site. If, after site characterization, the Yucca Mountain site is found to be suitable, the Secretary of Energy may submit to the President a recommendation that the President approve the site for development as a repository. This recommendation must be accompanied by an EIS for a repository.

The National Environmental Policy Act (NEPA) governs the process and procedures surrounding the scoping, preparation, and issuance of an Environmental Impact Statement (EIS). This NEPA section addresses DOE's NEPA strategy relative to transportation of spent nuclear fuel and high-level radioactive waste in the State of Nevada via highway and rail to a potential repository site. The NEPA strategy, detailed in the Civilian Radioactive Waste Management Program Plan (DOE 1994), focuses on one repository EIS that evaluates alternative transportation corridors in Nevada and utilizes updated national transportation analyses from the MPC EIS and the programmatic spent nuclear fuel EIS for incorporation as appropriate. Then, as performance confirmation and licensing efforts proceed and data increases over time, there may be a need to update the initial repository EIS to include significant new circumstances or information relevant to environmental concerns. For further information on the design process, see Section 5.1.1.

4.2.1 Environmental Impact Statement Content

A repository EIS that includes Nevada transportation system analyses would address potential environmental impacts from highway and rail transportation of spent nuclear fuel and high-level radioactive waste within the borders of Nevada to a potential repository site at Yucca Mountain. The rail analysis would provide examination of potential corridors to be used to construct a branch line in Nevada to transport the waste to Yucca Mountain.

The NEPA process requirements, 40 CFR 1502.14, state that EIS development shall:

> "(a) Rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated.

"(b) Devote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate their comparative merits."

Transportation analyses would likely focus on reviewing existing information for each alternative transportation corridor to determine social and economic constraints; technical feasibility and direct costs; land use and access constraints; likely environmental impacts of constructing and operating a branch line; and population radiation dose assessments. The highway analysis would examine potential impacts to existing highways for legal-weight truck shipments, as well as possible new roads or upgrades to existing roads for heavy-haul truck shipments within Nevada to Yucca Mountain.

The BLM should be requested to be a cooperating agency on the repository EIS in order to satisfy BLM's requirement for environmental analysis on a land withdrawal or right-of-way reservation. For additional land access information, see Section 4.4 of this document.

Conceptual engineering design would be undertaken during the initial phase (e.g., prior to and/or during scoping) of the EIS to provide essential information to conduct appropriate baseline studies and environmental impact analyses in the EIS. For more information, see Section 5.1.2 of this document.

4.2.2 Environmental Impact Statement Process

The major elements of an EIS are briefly described in this section and include the following:

- Public scoping
- Implementation Plan
- Baseline data collection
- Impact analysis
- Draft EIS
- Final EIS
- Record of Decision.

During the public scoping process, the public is invited to provide input on the scope of issues to be considered in the EIS. Public scoping is initiated when the Notice of Intent to prepare the EIS is published in the Federal Register. Many members of the public, interested groups, Indian tribes, and Federal, state, and local agencies are expected to participate in the EIS scoping process. As soon as possible after the last public scoping meeting, an EIS Implementation Plan would be prepared. The Implementation Plan would provide guidance for the preparation of the EIS and record the results of the scoping process. The Implementation Plan would include:

- The purpose of the proposed action
- An annotated outline of the EIS, based on the results of public scoping
- A description of the scoping process and the results, including a summary of comments received and their disposition

- A target EIS schedule
- Expected consultations with Federal, state, and local agencies, and other groups
- A disclosure statement (no conflict-of-interest) by any contractors hired by DOE to help prepare the EIS (in accordance with 40 CFR 1506.5(c)).

The information gathered during the baseline data collection phase of the EIS would be used to analyze potential environmental impacts to various disciplines (e.g., air quality, terrestrial ecosystems, cultural resources, socioeconomics). Baseline data is needed to describe the "Affected Environment" section of the EIS; impact analyses are included in the "Environmental Consequences" section of the EIS. A draft EIS would be prepared and disseminated for public review and comment. After public hearings on the draft EIS to receive comments on the document, the DOE would revise the draft and publish the final EIS. Upon completion of the final EIS, a 30-day waiting period would elapse before DOE would make a decision on the proposed action examined in the EIS. This decision would be recorded in a Record of Decision which is published in the Federal Register.

4.2.3 Schedule

The repository EIS is estimated to take five years due to the complex issues to be addressed and the data required for analysis. A possible update to the repository EIS may be necessary to augment initial EIS analyses based on the most current stage of operational activities and information resulting from confirmatory studies and data collection. The schedules for EIS development with and without additional EIS analysis are shown in Figures 8-1 and 8-2 of this study.

4.2.4 Issues for Consideration

4.2.4.1 Multi-Purpose Canister Environmental Impact Statement

The MPC EIS is a separate (i.e., from the repository EIS) effort undertaken by the OCRWM Office of Waste Acceptance, Storage, and Transportation to evaluate the potential environmental impacts of DOE's proposal to fabricate and deploy an MPC system in 1998. The repository EIS would incorporate by reference, as appropriate, the methodologies and results of national transportation impact assessments (including both highway and rail analyses) conducted for the MPC EIS, updating these assessments where necessary and appropriate. As such, the MPC EIS studies are necessary as a precursor for detailed Nevada transportation system analyses in the repository EIS. If the MPC EIS is delayed, initiation or completion of the Nevada transportation system analyses in an EIS could also be delayed.

4.2.4.2 Funding Increases

The Civilian Radioactive Waste Management Program Plan for Yucca Mountain Site Characterization (DOE 1994) includes funding for Nevada transportation system analyses in the repository EIS. Should more route-specific analyses be deemed necessary, additional funding would be needed for this effort.

4.2.4.3 Bureau of Land Management Involvement

There is a possibility that the BLM would not become a cooperating agency and/or would not adopt the EIS as adequate to meet their requirement for environmental analysis of a land withdrawal or right-of-way reservation for a rail spur. This would cause delays and could lead to the BLM performing their own separate environmental analyses. This could delay construction of the rail spur because right-of-way acquisition would be postponed until after BLM's separate environmental analysis.

4.2.4.4 Public Involvement

Public participation occurs throughout the EIS process, but particularly during public scoping and review of the draft EIS. The public scoping process and review of the draft EIS may identify issues not foreseen at this time that could potentially delay the repository EIS.

4.3 REGULATORY, PERMITTING, AND LICENSING ISSUES

Potential environmental regulatory requirements that may apply to the construction and operation of a transportation system in Nevada are described in this section. Permits and required agency consultations would take about two years to complete, but would not be a critical path scheduling item because these requirements could be satisfied concurrent with NEPA and access requirements. Based on current interactions to obtain permits for site characterization, Nevada regulatory agencies are not expected to delay issuing permits to construct rail or highway facilities. Regulations, executive orders, ordinances, and statutes encompassing all aspects of spent nuclear fuel and high-level radioactive waste transportation are summarized in the following sections.

The potential effects on public health and safety and the environment resulting from the transportation of the radioactive waste to the Yucca Mountain site are addressed on a Federal, state, and local level. Because the laws and regulations governing radioactive waste transportation are constantly evolving, consultation with the appropriate Federal, state, or local agency is still essential throughout the planning and implementation stages of the project. The purpose of this regulatory overview is to identify the regulations as they pertain to highway or rail transportation of spent nuclear fuel and high-level radioactive waste within the Nevada border; the regulatory transportation requirements concerning shipments from the generators to the Nevada border will not be covered in this document.

4.3.1 Air Quality

Air quality is regulated by the Clean Air Act and the 1990 Clean Air Act Amendments, which establish Federal policy for protecting and enhancing the quality of the nation's air resources for the benefit of the public health and welfare. The Act ensures, through a state-issued permit program, that adequate steps are taken to control the release of air contaminants from industrial processes and land-disturbing activities. In 1980 the U.S. Environmental Protection Agency (EPA) approved Nevada's plan to implement and enforce the Clean Air Act, and in 1988, the agency granted Nevada the authority to implement the

Prevention of Significant Deterioration Program of the Act. However, authority to regulate radioactive air emissions has been retained by EPA.

The Nevada Division of Environmental Protection within the Nevada Department of Conservation and Natural Resources is responsible for implementing and enforcing the Clean Air Act in Nevada. Section 118 of the Act requires Federal agencies to comply with all Federal, state, interstate, and local requirements, administrative authority, and processes and sanctions respecting the control and abatement of air pollution in the same manner, and to the same extent, as any non-governmental entity.

Construction activities such as highway and railroad construction will generate particulate and gaseous emissions of air pollutants. Most particulates will be generated during highway and rail construction activities by drilling, blasting, rock removal and storage, surface grading and leveling, wind erosion, vehicle travel, and from diesel and gasoline engines and generators. Emissions associated with the construction activities are subject to examination under the Act's regulation on Prevention of Significant Deterioration. Initial analyses indicate that air emissions would be considerably less than the 226.9-tonne (250-ton) per year threshold for each pollutant that would classify the source as major (DOE 1986). However, the Las Vegas metropolitan area is currently considered non-attainment for carbon monoxide and serious non-attainment for particulate matter. Thus, Prevention of Significant Deterioration permitting probably will be required for construction activities in the Las Vegas metropolitan area if the threshold limits of 90.8 tonnes (100 tons) per year for carbon monoxide and 63.5 tonnes (70 tons) per year for particulate matter are exceeded.

An air quality permit to construct will be required if construction will disturb more than 8.1 ha (20 acres) of land per year (the minimum acreage of surface disturbance per year that triggers permit requirements). Point source emissions from equipment such as any concrete-batch plant will also require a permit to construct and an operating permit because these sources would exceed a process weight rate of 22.7 kg (50 pounds) per hour. A separate permit to construct is required for each new single source of contaminants.

The appropriate permit application forms must be completed and submitted to the air quality officer. An operating permit will be applied for within six months after receipt of the permit to construct. Assuming that air quality violations do not occur after issuance of the permit to construct, operating permits must be granted if the air quality officer finds (from an appropriate test at the new source) that the sources will not result in any violation of the state air quality regulation or 40 CFR 60-61. Operating permits must be renewed five years after the date of issuance.

4.3.2 Water Resources

The preservation of water quality and water appropriation is controlled by Federal and state laws. Highway and rail construction activities may have the potential to directly or indirectly affect the water quality of the state. The Clean Water Act was established to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The Act provides for (1) the EPA or Federally-authorized states to implement permit programs for regulating the discharge of pollutants to navigable waters from any point source; (2) Federal

effluent limitation for discrete discharges, and pretreatment standards for discharges into publicly-owned treatment works; (3) a program to regulate oil and hazardous substances; (4) control of stormwater discharged from facility and construction sites; and (5) a permit system for the use of dredge and fill material.

Nevada's regulation on National Pollutant Discharge Elimination System permits (Nevada Annotated Code 445.140 through 445.178) requires submission of a completed application form, along with a fee, to the water quality officer in the Nevada Division of Environmental Protection. Discharge points that could be added to the permit application form include discharge from rock storage piles, mine wastewater ponds, and miscellaneous pump tests. The permits may contain written effluent limitations. These limitations are based on a variety of criteria including the effects of the discharge on receiving waters and the use of the receiving waters. The permit may also require, at the water quality officer's discretion, the installation, use, and maintenance of equipment to monitor specified pollutants, and the retention of monitoring records, generally for three years. The water quality officer has the authority to enter any premises on which a permitted discharge is located to access and copy records, inspect monitoring equipment, and sample discharges.

At the state level, the Nevada Water Pollution Control Law (Nevada Revised Statute 445.2533) empowers the state to maintain the quality of Nevada waters for public health and enjoyment, protection of animal life, operation of existing industries, the pursuit of agriculture, and the economic development of the state.

The Nevada Division of Environmental Protection defines "waters of the state" to include water courses, waterways, and drainage systems, as well as all underground water. Dry washes such as those at Yucca Mountain are considered by the state to fall within this definition. The Nevada Division of Environmental Protection requires that discharges of pollutants into the subsurface be controlled, if the potential for contamination of surface or groundwater supplies exists. If the Nevada Division of Environmental Protection determines that there is a potential for groundwater contamination, a zero-discharge permit will be required. Initial analyses suggest that the potential for such pollution is remote because of the depth of the groundwater beneath Yucca Mountain; however, further analysis may be necessary on a case-by-case basis dependent on the selection of highway or railroad routes (DOE 1986).

The Nevada Water Pollution Control Law also empowers the State Environmental Commission to prescribe controls on diffuse sources of pollutants, if these sources could seriously degrade the quality of waters of the state. Although run-off from construction sites is a "diffuse" source of pollutants, it is anticipated that such run-off will not seriously degrade any waters of the state. Several potential sources of water contamination are associated with the highway or railroad construction phases that represent potential adverse effects to surface and groundwater sources. These potential contamination sources associated with construction activities include petroleum products (diesel fuel), oils and lubricants, solvents and volatile organic compounds, and other toxic or hazardous materials. These sources are typically associated with on-site fuel tankers, temporary above ground fuel storage tanks, refueling, vehicle and equipment field maintenance, spills, and leaks. Due to the arid climate, the potential for floods and surface runoff to carry contaminants off site and to the

publicly-accessible environment is limited. Furthermore, once constructed, the potential for highways and railroads to contaminate surface or groundwater sources will be significantly reduced. Primary sources of contamination include fuel spills and oil stains on highways or railroad track which could lead to stormwater runoff contamination. Some activities may require a Stormwater Discharge Permit prior to start of construction.

The Safe Drinking Water Act grants the EPA authority to regulate public drinking water supplies by establishing drinking water regulations, delegating authority for enforcement of drinking water standards to the states, and protecting aquifers from such things as injection of wastes and other materials into wells. In 1978 the EPA approved Nevada's program for enforcing the drinking water standards established by the EPA, administered by the Nevada Division of Health within the Nevada Department of Human Resources. Enforcement of the Underground Injection Control program has been delegated to the State of Nevada. It is not anticipated that the Safe Drinking Water Act of 1974, as amended, requirements will be applicable to the highway and rail construction activities. However, if any buildings (with running water, sewer, and electricity) are constructed, such as for the intermodal transfer facility, these requirements will be addressed.

During ground disturbing construction activities, water for fugitive dust control will be required. To prevent interference with prior water rights, a water appropriation permit must be obtained from the Nevada state engineer. This process begins with submission of an application to the Nevada state engineer.

4.3.3 Protection of Environmental and Cultural Resources

Endangered species are protected on the Federal level by the Endangered Species Act. Accordingly, any Federal activity or Federally-supported activity that could directly affect protected fish, wildlife, or vegetation, or destroy or alter the specific habitat of protected species, must be designed to avoid or mitigate all potentially adverse impacts. Compliance requires determining whether any species occurring in the area of proposed highway or rail construction activities is considered by the U.S. Fish and Wildlife Service to be threatened or endangered. Discovery of such a species in the construction area would require an evaluation, in consultation with the U.S. Fish and Wildlife Service, of the impact of the construction on the species, and if necessary, development of plans to avoid or mitigate impacts to the species. The U.S. Fish and Wildlife Service would issue a biological opinion to document their findings and requirements.

At the state level, the Nevada State Wildlife Statutes provide for management and protection of various types of wildlife including game animals, birds, fish, amphibians, fur-bearing animals, and all protected, rare, threatened, or endangered species. The State of Nevada, via the Nevada Department of Wildlife, manages game on BLM lands through cooperative agreements with the BLM. Because the Yucca Mountain site is partly on BLM land, the Nevada Department of Wildlife must be contacted to ensure that the wildlife is adequately protected. Moreover, if protected animals are to be captured, removed, or destroyed, a permit must first be obtained from the Nevada Department of Wildlife. The desert tortoise, classified by the state as "rare" and by the U.S. Fish and Wildlife Service as "threatened,"

inhabits the Yucca Mountain region. The Nevada Department of Wildlife will be consulted to ensure that all wildlife is adequately protected.

Identification, preservation and mitigation of impacts to significant archaeological, historic, or cultural properties must be considered during construction activities. The National Historic Preservation Act is the principal authority to which the DOE will respond in regard to the protection of historic properties. The Act requires all Federal agencies to take into account the effects of their undertakings (such as construction) on historic properties. Historic properties are defined as any properties included in, or eligible for inclusion in, the National Register of Historic Places.

A Federal agency must undertake a three-phase process consisting of (1) a survey of the area to identify and evaluate any historic/prehistoric sites; (2) if resources are identified, a determination of either "no effect," "no adverse effect," or "adverse effect;" and (3) if the determination is "adverse effect," a consultation with the state historical preservation officer and the Advisory Council on Historical Preservation to consider alternatives or mitigating measures. The process may be modified upon agreement between the agency and Advisory Council on Historical Preservation to design an approach which is tailored to meet the needs of a specific program. This is done by development of a programmatic agreement.

The programmatic agreement, developed with the Advisory Council on Historic Preservation describes the steps to be taken to ensure compliance with the American Indian Religious Freedom Act, and ensures that historic properties of cultural or religious value are identified and avoided or mitigated. Under the stipulation of the programmatic agreement, consultation is required with the U.S. Bureau of Indian Affairs and local tribes having current or historic ties to the land, as well as with other parties. Contact with Native American tribes regarding cultural or religious sites is also required by the Archaeological Resource Protection Act and its implementing regulation if archaeological investigation may disturb these locations.

The purpose of the American Indian Religious Freedom Act is to require Federal agencies to consider Indian religious values when undertaking Federal projects that affect land use. This Act is applicable to all construction activities that could directly or indirectly affect sacred or religious sites and practices of Native Americans. Determinations as to whether a proposed highway or rail route is related to religious rites or is a sacred site of any Native American group will be made. If the selected route is a site of religious practice, consultations with Native American leaders will be necessary to determine whether the construction would infringe on the free exercises of that religion. If such infringement could occur, alternative route(s) (in consultation with Native American leaders) will be considered and evaluated to determine which alternative will minimize impacts on Native American religious practices while still meeting transportation goals.

The Archaeological Resources Protection Act protects archaeological resources and sites which are on public lands and Indian lands, and fosters the exchange of information between involved individuals and entities. The Act applies to all construction activities that affect Federal lands. Compliance with the National Historic Preservation Act requires that adequate investigation be conducted to identify cultural resources protected under Archaeological Resources Protection Act.

On lands owned or controlled by the U.S. Government, the Antiquities Act and its regulations protect historic and prehistoric ruins, monuments, and objects of antiquity (including paleontological resources). Any person who appropriates, excavates, injures, or destroys any historic or prehistoric ruin or monument or any object of antiquity situated on lands owned or controlled by the U.S. Government must have the permission of the Secretary of that department of the government having jurisdiction over the land.

4.3.4 Noise

The purpose of the Noise Control Act of 1972 is to promote an environment free of harmful and damaging noise. The Act applies to all activities that generate significant noise. Federal agencies must carry out their programs in a manner that promotes an environment free of noise that could jeopardize public health and welfare. Federal agencies must also comply with state and local requirements for the control and abatement of environmental noise. No State of Nevada or local noise abatement requirements have been identified to date. Hence, construction and daily operations involving both road and rail transportation will be controlled and the noise levels will be monitored in accordance with the Noise Control Act.

4.3.5 Hazardous Waste

The Resource Conservation and Recovery Act is a comprehensive program for regulating and managing hazardous wastes, nonhazardous solid waste, and underground storage tanks, and for promoting the use of recycled and recovered materials. On November 1, 1985, EPA granted final authorization to the State of Nevada for administering the management and disposal of hazardous wastes. The EPA Region IX holds the Nevada Division of Environmental Protection responsible for implementing and enforcing this part of the Act.

Construction of highways or railroads may involve the use of small quantities of hazardous substances (e.g., solvents, road sealants, paint, paint thinner, epoxy, and standard vehicle fluids such as antifreeze, lubricants, and petroleum products). Hazardous materials, and the resulting hazardous wastes, will be stored using appropriate safeguards as provided in the Resource Conservation and Recovery Act.

The Yucca Mountain Project has acquired a separate Resource Conservation and Recovery Act generator EPA identification number from the Nevada Division of Environmental Protection. Hazardous waste will be handled in accordance with these requirements.

As part of the requirements, determination and documentation of the amount of hazardous waste being generated during each month of construction is required. The Yucca Mountain Project is currently classified as a small quantity generator, defined as generating greater than 100 kilograms but less than 1,000 kilograms of hazardous waste per month. The anticipated hazardous waste generation attributable to road or rail construction activities would not result in any significant increase in monthly hazardous waste generation nor cause the small quantity generator status limits to be exceeded.

4.3.6 Materials

The Materials Act of 1947 authorizes the land management agencies, such as BLM and the U.S. Forest Service, to make available to Federal and agency contractors common varieties of sand, stone, and gravel. Should the contracts acquire these materials from a borrow area on BLM land, the materials must be purchased from BLM and, therefore, the Materials Act would not be applicable. To obtain a free-use permit, an application must be filed with BLM. The application must contain a description of the location of the proposed borrow area(s), the purpose for which the material will be used, and the amount of material that will be extracted.

4.3.7 Transportation

This section presents an overview of the above statutory and regulatory requirements governing the transportation of spent nuclear fuel and high-level radioactive waste. Multiple regulatory programs are in place that set minimum standards for vehicle equipment, driver qualifications, and commercial motor carrier operation, as well as authorization to ultimately select the hauling routes for vehicles. The primary statutory authority governing hazardous waste (which includes radioactive waste) is the Hazardous Material Transportation Act as amended by the Hazardous Materials Transportation Uniform Safety Act of 1990. The Act is implemented and enforced by DOT, EPA and NRC; these agencies have established transportation-related requirements for hazardous substances and wastes and radioactive material. The Occupational Safety and Health Administration is responsible for the health and safety of personnel employed by the hazardous materials carriers. These regulations are discussed below.

The Atomic Energy Act of 1954 authorizes NRC to regulate the receipt, possession, use, and transfer of source byproduct, and special nuclear material, which includes spent nuclear fuel and high-level radioactive waste. The DOT and NRC have established a Memorandum of Understanding to outline the responsibilities of each agency. The NRC establishes the design and performance standards of packaging for the radioactive waste; conducts inspections of licensees; and requires advance notification to states for physical security of certain materials. The DOT has regulatory authority over packaging used to transport low-level radioactive materials and transportation operations for high-level radioactive materials.

Advance notice must be given in writing to NRC's Division of Safeguards and Transportation, at least 10 days prior to beginning shipment. As part of the notification, the modes(s) of shipment, transfer point(s) and route(s) to be used, the estimated time and date that shipment will commence, and the estimated time and date of arrival of the shipment at the destination must be detailed in the shipment itinerary. Any changes to the shipment itinerary requires telephone notification to the Division of Safeguards and Transportation. In addition to advance notice requirements, security and safeguards, such as required escorts, are regulated.

The Hazardous Material Transportation Act provides DOT with regulatory and enforcement authority to protect the nation from the risks of transporting hazardous materials. Thus, highway or rail transportation of spent nuclear fuel and high-level radioactive waste must

meet the requirements of this Act, unless the state regulations afford an equal or greater level of protection to the public and do not otherwise unreasonably burden commerce.

Shippers, carriers, and handlers of hazardous materials are required to comply with DOT requirements associated with 49 CFR 171-178, which include operational procedures for packaging, handling, labeling, and placarding shipments of hazardous material. The DOT regulations require each person who engages in any of the specified activities relating to the transportation of hazardous materials to register annually with DOT and pay a fee of $300. Regarding State of Nevada specific requirements, consultation with DOT and the Nevada Department of Transportation indicates that as long as DOE-certified transporters are used, and those transporters follow DOT criteria, no further consultation will be required.

The EPA regulations set forth in 40 CFR 262-263 establish the responsibilities of generators and transporters of hazardous waste (which includes material that spontaneously emits ionizing radiation - termed Class 7 radioactive material). In these regulations, EPA has expressly adopted certain DOT regulations governing the transport of hazardous materials.

Transportation of spent nuclear fuel or Class 7 (radioactive) material by rail pursuant to 49 CFR 174 stipulates inspection requirements of railcars and vehicles to ensure the cars are in a safe condition for transporting. Each carrier, including connecting carriers, shall perform the duties specified, comply with all applicable requirements, and train its employees who handle these types of shipments.

For road shipments of Class 7 (radioactive) materials, 49 CFR 397 Subpart D, requires a written route plan. Any variation between the route plan and routes actually used, and the reason for it, shall be reported in an amendment to the route plan delivered to the shipper as soon as practical but within 30 days following the deviation. The route plan must contain (1) a statement of the origin and destination points, the route selected, all planned stops, and estimated departure and arrival times; and (2) telephone numbers which will access emergency assistance in each state to be entered. Additionally, according to 49 CFR 172 Subpart H, transportation of Class 7 materials on public highways requires (1) the driver be trained as required by 172 Subpart H and 77.816, (2) a copy of the record of training required by 172.704 be in the immediate possession of the driver, and (3) the route plan be in the immediate possession of the driver, and that the driver adheres to this plan.

State of Nevada Transportation Requirements

Nevada has adopted Title 40 of the Code of Federal Regulations, which addresses the transportation of hazardous materials. The State of Nevada regulatory programs related to transportation primarily address notification of state and local governments. Specifically, haulers must notify the state if they transport high-level radioactive waste and spent nuclear fuel shipments through or into the state. Notification must be made to the Governor's office. Transporters are subject to specific state statutes requiring permits for transporting hazardous waste and requiring inspection of vehicles. Additionally, notification to the Nevada State Highway Patrol at least 4 hours but not more than 48 hours in advance of initiating the transport is required prior to transporting controlled quantities of radioactive materials or radioactive waste (high-level and low-level).

The State Environmental Commission has adopted the Federal regulations applicable to transporting hazardous waste. Transporters may also be subject to extensive regulation as an operator of a facility for the storage, treatment, or disposal of hazardous waste unless the transporter meets certain packaging requirements and the hazardous waste is only stored on the transporter's premises for less than 10 days.

Special Nevada Requirements Governing Heavy Hauls

Nevada Revised Statutes govern heavy hauls on highways, stipulate allowable weight and size of vehicles and require permits for oversized vehicles or loads. Under Nevada statutes, the supervising board of county highway commissioners or the board of county commissioners may regulate the maximum load that may pass over a section of public road or highway; and may close a section of public road or highway if damaged.

Nevada statutes detail the prohibitions concerning size or weight of vehicles and identify the special permit exceptions. The maximum limitation for size and weight of gross loaded weight is specified by the statute. For widths in excess of legal maximums, a special permit for oversized structures is required from the Nevada Department of Transportation. Additional stipulations govern the movement of vehicles or structures 3.0 to 4.3 m (120 to 168 in) in width which include wide-load signs and red flags, and operation of low lights on the towing vehicle. The Nevada Department of Transportation designates the highways over which the vehicle or structure in excess of 3.0 m (120 inches) in width may be moved, and may require a pilot car to precede or follow the load as well as stipulate times and days when such moving is permitted and additional safety precautions to be taken. The Nevada Department of Transportation may allow operation of vehicle combinations in excess of 32.0 m (105 ft) for over legal-size trucks. In addition to physical restrictions, the Nevada Department of Transportation places additional reservation for the operation of vehicles permitted on highways where, in the opinion of the department, their use would be inconsistent with the public safety because of a narrow roadway, excessive grades, extreme curvature, or vehicular congestion. The permits may be restricted in such a manner as the Nevada Department of Transportation considers necessary and may, at the option of the department, be cancelled without notice.

Regulatory Issues Associated with Intermodal Transfer Facility

The MPC system is designed to accommodate storage, transportation, and disposal of spent nuclear fuel. The MPC will be loaded at the reactor before transportation to Yucca Mountain. However, without rail service to all reactor facilities, heavy-haul trucks may be required for transport of the MPCs to a rail spur. Therefore, the MPC would need to go through an intermodal transfer prior to reaching its final destination at Yucca Mountain. One possible scenario is that the spent nuclear fuel is loaded into an MPC at a reactor, transferred to a rail spur, and shipped via rail to an intermodal transfer location somewhere within the vicinity of Yucca Mountain. The MPC is then transferred via crane to another mode of transportation (i.e., special flat-bed truck) and moved to the Yucca Mountain facility.

The MPC will receive certificates of compliance in accordance with the requirements of 10 CFR 71 and 72. Part 71 addresses the transportation requirements for package design,

testing, and indirectly by reference to 49 CFR, the transportation requirements for moving the radioactive waste by rail, water, or highway. The requirements of 49 CFR are DOT regulations and are included as part of 10 CFR 71 by reference. The regulation 49 CFR 174 includes the requirements for shipment by rail and 49 CFR 177 includes the requirements for shipment over public highways. 10 CFR 72 addresses the storage requirements for package design and siting are addressed by 10 CFR 72. These regulations will govern MPC usage for transportation and storage.

The DOT regulations include requirements for transit, storage incident to transport, and requirements for expediting shipments. These regulations are organized by mode of transport and include all the requirements for that specific mode. No special licensing requirements exist for intermodal transfer.

When a shipping cask is certified as meeting the requirements of 10 CFR 71, NRC issues a certificate of compliance that includes provision for a general license. This provision allows a user to ship radioactive material provided that certain conditions are met, and allows shipment of the fuel by rail, barge, or highway. The MPC will receive a certificate of compliance; therefore, spent nuclear fuel can be shipped in an MPC by any mode of transport as described above.

The Shoreham to Limerick experience is a recent example of intermodal transfer. The Shoreham Nuclear Power Station in New York was shut down, and decommissioning commenced in 1993. The decommissioning plan included transfer of the reactor fuel to Limerick Generating Station in Pennsylvania between September 1993 and mid-1994. Shoreham shipped 560 fuel bundles via barge/rail to Limerick. The fuel was transported in an IF-300 transport cask. The fuel began its journey from the Shoreham reactor building on a heavy-haul vehicle to the barge slip on site. The barge then transported the fuel to Eddystone Generating Station where it was lifted using an on site crane to a rail car. Eddystone is a fossil generating plant in the Pennsylvania Electric Company (owners of Limerick Generating Station) system. The fuel traveled by rail from Eddystone to Limerick.

The licensing associated with this fuel transfer entailed mainly 10 CFR 50 licensing. Both facilities made changes to their licenses to accommodate either removing fuel or receiving fuel. There was no requirement to license the transfer or intermodal transfer. It should be noted that there was a great deal of intervention associated with the transfer, but the authorities made their finding on the side of the utilities and the transfer proceeded. Consequently, if the MPCs must be moved from one mode of transportation to another, the requirements stipulated in 10 CFR 71 would govern the intermodal transport facility. As can be seen by the Shoreham/Limerick experience, no special license is required for the intermodal transfer station.

4.4 LAND ACCESS

The location of the potential repository at Yucca Mountain, in Nye County, Nevada, is not served by any type of heavy-duty transportation infrastructure; consequently, construction may be necessary.

Highway access from U.S. Highway 95 could be obtained through (1) the Nevada Test Site, Lathrop Wells Road (Gate 510), using the existing road; (2) a fairly short stretch (approximately 24.1 km/15 miles) of new roadway construction, located generally along the Fortymile Wash; or (3) the existing road through Mercury. The land in these areas is owned by the Federal Government. These routes involve lands administrated by both BLM and DOE under Public Land Orders 2568, 805, and 3759.

The railroad spur may come from the north, south or east depending on the route selection. It is likely that the route will pass over lands administered by BLM, DOE, or possibly the U.S. Fish and Wildlife Service.

The options to obtain access to the land necessary to construct a rail spur depend on the route chosen and the land administrator(s) of that particular route. If the chosen route lies on BLM-administered land, the methods include a right-of-way grant or withdrawal. The Federal Land Policy and Management Act requires that management of the public land be on the basis of multiple use and sustained yield. As a consequence, BLM would prefer the use of a right-of-way, which is less restrictive to use by the public than a withdrawal, unless there is a compelling reason for a withdrawal. In addition, a right-of-way can be initially granted for a longer time than a withdrawal, which is limited to 20 years. The DOE-administered Nevada Test Site is previously withdrawn by three public land orders: 805, 2568, and 3759. Private land use will require negotiation with the land owner for lease or purchase of the required land.

4.4.1 Process

The land access process should be started during EIS scoping, especially for the use of public land, because the EIS becomes a part of the case file for either a right-of-way or a withdrawal. Withdrawals must be completed within a two-year segregation period described in Section 4.4.2, or the application lapses. The process will be conducted under DOE Order 4300.1C, Real Property Management. The process will take two years after the issuance of the final EIS. Specific legislation for the project can alter this process or change time limits.

4.4.2 Acquiring Route Access

Public Land Right-of-Way

Rights-of-way procedures with the BLM are described in 43 CFR 2800. There are three phases of activity associated with the process: pre-application activity, application filing and application processing.

A. Pre-application Activity

Early contact should be established with BLM to identify constraints, establish timelines and decide which special studies (i.e., environmental assessment, environmental impact statements, etc.) will be needed.

B. Application Filing

Filings for related licenses or permits with other Federal or state agencies should be coordinated with and filed simultaneously with BLM applications. A free-use permit for sand and gravel, discussed in Section 4.3.6, is an example of a related permit.

The application requires a project description that includes an explanation of how the project will interact with existing and future projects, its affect on the environment, benefits provided to the public, safety of the project, specific public lands to be used (including areas for staging, laydown, and spoils storage), estimated construction schedule including manpower loading, a description of the construction technique to be used, and alternative route considerations.

A map, or maps, must be submitted showing the bearing and distance of the traverse line of the true centerline of the facility, at least one tie to a public land survey monument at the beginning or the end of the right-of-way (if the right-of-way crosses both BLM and other land, the right-of-way must be tied to a monument for each BLM parcel), exterior limits of the right-of-way, a north arrow, all subdivisions of each section or portion crossed by the right-of-way, with the subdivisions, sections, townships and ranges clearly and properly noted and at a scale such that all information is clearly legible.

C. Application Processing

The BLM-authorized officer will allow the applicant to use the land to gather data to perfect the application unless surface-disturbing activities will occur, in which case, a temporary use permit application will be filed, as described in 43 CFR 2800 and 2880.

The authorized officer must complete an environmental analysis in accordance with NEPA, determine compliance of the project with state and Federal law, and consult with all Federal, state, and local agencies having an interest in the project.

The authorized officer may hold public meetings if there is sufficient public interest. The officer may also place a provision in the right-of-way reservation that no construction can take place until construction drawings have been submitted and approved by BLM and a notice to proceed has been issued.

Right-of-way acquisition within the U.S. Fish and Wildlife Service wildlife refuge (e.g., the Desert National Wildlife Refuge) is described in 50 CFR 29.21. The process is similar to the BLM process, with one important exception: The U.S. Fish and Wildlife Service regional director must determine whether the requested use is compatible with the refuge (i.e., that the requested right-of-way will not interfere with or detract from the purposes for which units of the National Wildlife Refuge System are established).

D. Private Land

There will be a minimal impact on private land. It is expected, however, that some private land will be required. It is not a usual practice for DOE to use government power of eminent domain; however, it is an option. The desired DOE practice is to negotiate with private land owners until a settlement can be reached. It is expected that this negotiation process could occur in two years.

Public Land Withdrawal

The process for public land withdrawal is described in 43 CFR 2300. Applications require no specific form, but must contain the information identified in this regulation.

Within 30 days after application, a notice is published in the Federal Register. This publication will cause the land to be segregated for two years. The notice will also be published in at least one newspaper in the vicinity of the lands involved. The notice will solicit public comment for at least 90 days and provide for one or more public meetings if the application asks for 2,023 ha (5,000 acres) or more. Public meetings for acreage less than 2,023 ha (5,000 acres) are at the discretion of the authorized officer.

A case file is developed by the applicant for submission to the Secretary of the Interior or the Congress (the Secretary approves applications of less than 2,023 ha [5,000 acres], Congress approves those of 2,023 ha [5,000 acres] or more). The case file will contain a present user report; an analysis of requested water use; an environmental assessment or environmental impact statement; a floodplain or wetlands report; and a statement of consultation with other Federal, state, or local governments, individuals, or non-governmental groups.

If the Secretary approves, a Public Land Order is prepared and issued withdrawing the land. If the acreage exceeds 2,023 ha (5,000 acres), the Secretary is required to notify each house of Congress on the same day as the order. If the Congress does not pass a concurrent resolution denying the withdrawal within 90 days of the Public Land Order, the withdrawal stands. Withdrawals under these provisions cannot exceed 20 years duration.

4.4.3 Land Access Issues

Nevada Test Site Withdrawal Adequacy

Public Land Orders 805, 2568 and 3759, which withdrew the Nevada Test Site, are very general and were issued between 1951 and 1962. The intent of these Public Land Orders is the testing of nuclear weapons; consequently, the construction and operation of a transportation route for the disposal and/or storage of spent nuclear fuel and high-level radioactive waste may not be within their scope. A legal opinion should be obtained confirming their applicability. It may be necessary to modify them as part of the land access process.

Prior Existing Rights

Depending on the route chosen, prior existing rights on public land, such as mining claims, grazing allotments, existing rights-of-way, traditional lifeway areas, or existing withdrawals may be present. These rights are not normally eliminated with the issuance of a right-of-way or withdrawal. Mining claimants have a right to all the valuable minerals within their claims. They do not have the right to restrict other land uses, although mining operations can disrupt alignments. Grazing allotments may require fences and passageways through the alignment to reach sources of water. Additional studies along each proposed route will be required to define where these existing rights are located. The DOE may be required to obtain concurrence for use of the route with rights holders, especially in the case of existing withdrawals and rights-of-way. It is difficult, though not impossible, to obtain routes through wilderness areas, national parks, game ranges, and other areas of environmental concern. In most cases, it would be prudent to change the alignment to bypass these areas.

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5. TRANSPORTATION SYSTEM DEVELOPMENT

This discussion of the development of a transportation system within Nevada focuses on rail system design and construction and heavy-haul truck route development. The section explores design standards and regulations and construction and cost factors for both transportation systems.

5.1 RAIL SYSTEM DESIGN

5.1.1 Design Guidance for Rail Transport

The following subsections discuss design standards and DOE regulations that establish general and specific design policies and procedures for designing a rail system; the design schedule, including three required design activities; and methods of expediting the design activities.

Railroad Design Standards

The design standards published by the Association of American Railroads and the American Railway Engineering Association will be used to perform design activities for the rail system. The standards cover all aspects of the rail design, including roadway and ballast, track measuring systems, ties and wood preservatives, rails, track, buildings and support facilities, timber structures, concrete structures and foundations, concrete ties, yards and terminals, steel structures, clearances, waterproofing, and project management guidance.

DOE Order 4300.1C — Real Property Management

This order establishes the policies and procedures for the acquisition, use, inventory, and disposal of real property. The sections of the order that specifically apply to this transportation study are listed below.

- Chapter I, Acquisitions, identifies the acquisition planning, purchase of property, transfer of property from other government agencies, withdrawal of land from public domain, exchanges and donations, and leases. Section 2, Acquisition Planning, describes the requirements for developing a preliminary real estate plan. This plan is intended to serve as a decision document affecting all future site selection activity. The plan must be submitted as part of, or at the same time as, the Conceptual Design Report. Section 3, Purchase of Property, identifies the need for a DOE site investigation team to perform the activities required by the order. Section 8, Acquisition of Other Interests, covers easements.

- Chapter V, Management of Natural Resources, identifies the requirements for management of forest, soil and water, fish and wildlife, cultural resources, and national environmental research parks.

DOE Order 4320.1B — Site Development Planning

This order establishes the policies and assigns the responsibilities for the planning and development of DOE sites. The sections of the order that specifically apply to this transportation study are listed below:

- Chapter I, Section 1, Planning Process, defines the incremental steps used to perform site planning:
  - Identify and define current and future site missions
  - Evaluate existing conditions and regional influences
  - Determine and quantify facility requirements
  - Formulate alternatives to satisfy the requirements
  - Evaluate and rank alternatives based on their merits
  - Develop a plan of action to implement the preferred solution.
- Chapter II, Site Development Plan Format, describes the requirements of the Site Development Plan as a brief document that presents site development issues. This section of the order identifies the format for the plan.

The order states that "Site planning should not be accomplished in a vacuum and all affected parties should have input into the process. The Operations Office Manager shall determine the appropriate level of community involvement in the planning process . . . . The Operations Office Manager shall prepare a community relations plan that addresses the level of community involvement and plan of action and milestones."

The order also states that the planning process must be documented so that others may follow the site planner's thought processes. This documentation is titled "Technical Site Information," outlined in Section 1 of the order.

DOE Order 4700.1 — Project Management

DOE Order 4700.1 establishes the procedure for developing a design for a DOE facility or supporting system. The order requires the design to be performed in stages to allow sufficient control of the design process to ensure the completed design meets stated objectives: (1) achieving minimum construction costs consistent with programmatic, environmental, security, and safety requirements, (2) achieving technical adequacy, (3) achieving optimum economy in operation and maintenance, and (4) ensuring that appropriate consideration is given to the expected period of use, quality construction practices, and quality assurance requirements.

General design requirements were established in Chapter V, Procedures for Construction Management, Part C, Execution. They include development of a design criteria package, a conceptual design, a Title I design, and a Title II design.

DOE Order 6430.1A — General Design Criteria

DOE Order 6430.1A establishes general criteria for design of DOE facilities and supporting systems. The order further establishes criteria for railroad design, as shown in Table 5-1.

Table 5-1. Design Criteria for Rail Included in DOE Order 6430.1A

Section	Description
0110	Architectural and Special Design Requirements
	Design and Operating Requirements
	Alternative Designs
	Flexibility
	Operational Efficiency
	Health and Safety
	Fire Protection
	Environmental Protection and Pollution Control
	Energy Conservation
	Physical Protection (also Section 0283)
0111-4	Structural Systems for Highway/Railway Structures
0140	Quality Assurance
0150	Construction Facilities and Temporary Controls
0201	Subsurface Investigations
0202	Surveying
0203	Utilities within Easements or Corridors
0210	Site Preparation
0220	Earthwork
0245	Railroad Design
0250	Paving and Surfacing
0262	Corrosion Control
0276	Construction in Floodplains or on Wetlands
0279	Exterior Communications and Alarm Systems
0280	Site Improvements
Division 3	Concrete
0512-7	Structural Steel for Highway and Railway Structures
0514-1	Structural Aluminum for Highway and Railway Structures
0610-2	Wood and Plastics for Highway and Railway Structures
Special Facilities	Requirements for Radioactive Materials Handling

At a minimum, these sections of DOE Order 6430.1A will be used to develop the design. Additional sections, either cited within the sections listed, or required for specialty systems design, may be incorporated into the design criteria during the design process.

Additional Operating Requirements

In addition to established Association of American Railroads and American Railway Engineering Association standards, operating requirements may be imposed by the Class I carriers and the Federal Railway Administration for rail system transport of radioactive material. Additional requirements may include speed limits, dedicated train requirements, upgrading existing track in certain areas, and other operating conditions that would minimize rail industry liabilities.

The applicable Federal rules that support the rail systems to be used for transport of radioactive material, both in the State of Nevada and across the country, must be included in the scoping process to allow rail industry concerns to be addressed. Also, established carrier policies must be evaluated to determine which are applicable to the rail design.

Environmental Impact Statement Scoping Design Input

The NEPA process begins with the scoping process by including the EIS review agencies and the public into the evaluation of alternatives. The conceptual design activity must be coordinated with the scoping process to provide sufficient information on proposed routes to allow evaluation of the alternatives by people participating in the scoping process. At the scoping stage, the alternatives that are considered non-feasible (based on the information available in the Preliminary Rail Access Study [YMP 1990b] and this study) can be discussed and screened from further evaluation; conceptual design of these alternatives is not necessary. The scoping process allows future reviewers of the draft EIS to identify those design activities, environmental studies, and environmental surveys they consider to be required to develop a complete EIS. Some of the evaluation criteria identified in the scoping process will be incorporated into the conceptual designs, and the remainder will be incorporated directly into the EIS document.

The draft EIS preparation includes the performance of required studies and surveys, additional design activities to revise the conceptual design to meet minimum requirements established in the scoping process, identification of environmental impacts for each alternative, and description of any required mitigation for each alternative.

The draft EIS does not have to conclude with a single preferred alternative; several options can be determined to be suitable. The preferred alternative may be selected following the draft EIS review period, and incorporated into the final EIS.

The EIS process scoping meetings should result in a comprehensive list of:

- Feasible routes, either rail or heavy-haul truck, that will be developed further in the conceptual design phase and incorporated into the EIS. Non-feasible routes, identified as alternatives in the Preliminary Rail Access Study (YMP 1990b) and

this study, will be screened out from further development in the scoping process. Other routes, in addition to those identified in the Preliminary Rail Access Study, may be identified in the scoping process.

- The type and detail of the information to be incorporated into the conceptual designs for those routes selected for further evaluation by the scoping process. Negotiations with the review agencies will determine the level of design effort required to provide sufficient information in the conceptual design to allow comparative evaluation of the alternatives. The basis for the design level of effort are the requirements listed in DOE Order 4700.1.

- Additional design criteria, other than rail or heavy haul industry practice criteria, to be used to develop the Title I design. Additional criteria may include aesthetics along certain areas of the route, upgrades to existing facilities adjacent to the route, noise limitations, grade separation and drainage structure design requirements and locations, and other design limitations exceeding, or not specifically addressed, in existing guidance standards.

- Applicable local permit requirements.

- Specific land parcels within the route corridor to be excluded from use in establishing the specific route. If certain environmentally sensitive or historically important land parcels or structures are within the possible route corridor, but are not protected under existing legislation, they may be identified during the scoping process as areas to be excluded from the route selection design.

- Environmental impact studies that may ultimately affect the route design (determination of wetlands, historical and archeological sites, existing hazardous waste areas, and other studies that may affect route selection).

5.1.2 Design Schedule

The design schedule includes three separate design activities, in accordance with the requirements of DOE Order 4700.1 and DOE Order 6430.1A: conceptual design, Title I design, and Title II design. Conceptual designs will be performed to provide sufficient information to evaluate the feasibility of the proposed project, and allow comparison of proposed alternatives during EIS review.

The conceptual design will be performed prior to, and during, the NEPA process to support evaluation of feasible alternatives, and establishment of requirements for environmental impact studies. Currently, four alternatives have been identified for further evaluation. The NEPA scoping process will determine how many of these or other alternative routes will have conceptual designs.

The Title I design activity refines the design of the preferred alternative selected in the NEPA process. The conceptual design for that alternative is revised to incorporate comments generated during the NEPA process, and to incorporate additional data (such as actual

topographic survey data) collected during the Title I design activity duration. The additional data collection allows a more accurate project cost and construction schedule to be developed.

The Title II design activity incorporates comments made to the Title I design, and completes the design to the issued-for-construction stage. Upon completion of the Title II design, the design package will be complete, and ready for incorporating into the bid packages developed for contractor selection. The Title II design will include a detailed cost estimate and construction schedule, which will be used to evaluate bid proposals.

The following sections describe the specific items to be included in each of the design activities, and estimated duration for each activity.

5.1.2.1 Conceptual Design

The conceptual design activity is estimated to take 12 months, based on the actual time required to complete the conceptual portion of the design for the Caliente route (SAIC 1992). This design work includes activities that go beyond the scope of conceptual design: the environmental report, geotechnical report and hydrology report are considered Title I design activities.

A conceptual design will be completed for all feasible alternatives that have been selected through the NEPA scoping process. The first six months of the conceptual design process will be used to develop sufficient information for each feasible route, to allow the NEPA scoping process to be initiated. That information will include identification of general alignments, profiles of the alignments, evaluation of drainage structure and grade separation requirements, calculation of quantities for each alignment, and identification of specific land-use conflict areas adjacent to the proposed alignment.

The final six months of the process will be used to complete the conceptual design for the routes selected for further evaluation during the NEPA scoping process. The level of detail will be identified through the scoping process. Lead and review agencies, and public groups, will identify concerns that will be evaluated during the development of the conceptual design. Some evaluation criteria, such as environmental impacts, will be investigated in the EIS, separately from the conceptual design documents.

The level of detail will be in accordance with the requirements of DOE Order 4700.1. At a minimum, conceptual design documents will include the requirements identified below.

- A general corridor at a scale sufficient to identify possible impacts to existing features.
- Identification of the location of any special features of the alignment requiring special engineering consideration, such as bridges, tunnels, stream crossings, wetlands, road crossings, intermodal transfer stations, etc.
- Design criteria to be used for detailed (Title I and II) design. The design criteria will be broad enough to cover the selection of any of the proposed alternatives.

- Identification of the permits required for construction of all proposed alternatives.

- A cost estimate and schedule analysis for the alternatives (including cost estimate for performing Title I and Title II design).

5.1.2.2 Title I Design

The Title I design activity has an estimated duration of 12 months, assuming the route selected is not significantly different from the conceptual design for that route.

The conservative schedule must assume that the completion of the Title I design for the preferred alternative will not commence until the agency and public review period for the EIS is complete, and the preferred alternative has been approved.

The Title I design activity will be performed based on the conceptual design developed for the alternative selected. Changes to the conceptual design, based on the review comments, will be incorporated, and the following activities will be performed:

- A detailed topographic survey of the preferred alignment will be completed, and the conceptual design would be revised to incorporate actual topographic information.

- An established centerline alignment for the rail line will be developed and shown at a 1" = 2,000' scale.

- Value engineering evaluations of possible alignment detail alternatives will be conducted to ensure that the most cost efficient design is developed.

- Field as-builts of critical existing utilities and facilities will be tied in with the new construction.

- A railroad operation plan will be developed.

- General technical specification outlines will be prepared for the proposed action.

- A more detailed engineering and construction schedule and cost estimate will be prepared.

5.1.2.3 Title II Design

The Title II design activity has an estimated duration of 12 months based on historical data for design of rail projects of similar type and size.

Title II design activities result in a design package that is ready to be issued for construction. The Title II design includes complete drawings and technical specifications, detailed construction estimates and schedules, completed permit applications, and construction control plans (quality assurance project plan, management plan, and health and safety plan).

The cost estimate will be an engineering estimate that will be used to evaluate bid proposals. The construction schedule included in the Title II design package will serve as the milestone schedule, to be used by the bidders when developing proposals.

5.1.2.4 Expediting Strategies for Rail Design Activities

The Title I design activities could be expedited by beginning the process six months before final approval of the preferred alternative. The risk associated with an expedited Title I design activity will be contingent upon preliminary agency and public acceptance of one alternative over the others. If several alternatives seem to have preliminary acceptance, Title I design activities could be expedited by performing continued design on all alternatives receiving preliminary acceptance. Early start of Title I design could shorten the project schedule by approximately six months. Proceeding with Title I design requires fulfilling two DOE "key decisions" in accordance with DOE Order 4700.1.

Title II design activities could be structured to expedite the overall project schedule by using several design strategies, such as (1) performing the design work on scheduled overtime; (2) breaking the project into sections, and designing each section with a separate engineering team; (3) contracting the final portion of the design work in a design-build contract, allowing the construction contractor to finalize design details; and/or (4) designing the construction in phases (clearing, earthwork, base construction, railroad/pavement construction, appurtenances construction) and awarding the construction contracts in phases.

All the expediting strategies listed increase the risk of increased design costs due to rework of completed design to incorporate changes in adjacent or phased work, and loss of productivity due to multiple designers working on the same design effort. Use of expediting strategies such as scheduled overtime and multiple engineering teams could shorten the Title II design schedule by approximately three months.

Title II design work is an extension of the Title I design work, and while some activities associated with Title II design (such as technical specification development) could be performed in parallel with the Title I work, submittal and review of Title I and Title II design packages must still be completed sequentially.

5.1.3 Design Cost Drivers

The cost drivers for design of the railroad can be identified by discussing the separate design activities necessary to develop the final construction packages. The activities include conceptual design, NEPA process support, Title I design, Title II design, development of request for quotation packages for bidding the railroad construction, evaluation of bids, and Title III activities (Architect/Engineer support of the construction activities per DOE Order 4700.1).

The conceptual design activities include the costs to design several alternative rail routes, supplying sufficient information to allow comparative evaluations of the alternatives to be performed. The conceptual designs will be used to support the NEPA process. During the development of the EIS, design activities outside the conceptual design scope of work will be

performed to support environmental impact studies. Support of the EIS development may require that conceptual design packages be revised to change proposed alignments, or add information requested by the review groups.

Following approval of the EIS and selection of a preferred route, the Title I design will be performed. Title I design will include costs to perform actual topographic surveys of the preferred route, subsurface investigations, and as-builts of existing facilities to be tied in to the new rail line. The Title I design report will be submitted for review by the M&O and DOE contractors and revised as necessary to incorporate reviewer's comments.

Following approval of the Title I design report, the Title II design will be performed to complete the railroad design. Costs for Title II design include the development, submittal, and revision of the Title II design report.

Design function costs include development of the request for quotation packages. Additional design documents developed for the request for quotation include detailed quantity lists, engineering estimates broken down by contract package, special conditions, government-furnished-equipment lists, contract submittal requirements, measurement for payment schedules, Q-lists, Title III hold point requirements, and quality control requirements.

Design costs would include reviewing the technical portions of the bid proposals, determining which proposals were technically acceptable, and determining which proposals were not responsive on technical issues.

Following contract award, the design group would be responsible for performing Title III Architect Engineer support functions to provide oversight of construction activities, resolve construction/design problems, approve design change requests, and inspect quality assurance hold point construction activities. The completion of the construction will require that the design group develop as-built drawings and specifications based on approved design changes, and red-lined construction drawings.

5.2 RAIL SYSTEM CONSTRUCTION

The construction schedule includes two construction activities: contractor selection and construction. The specific items associated with these two activities are described in the following sections.

The full contractor selection process consumes an estimated 8 to 12 months, based on historical government contracting activities for major construction projects of similar complexity. The process includes (1) request for proposal development, four months; (2) issue request for proposal for bid and allow proposal development time, one to two months; (3) bid evaluation, one to two months; (4) request for best and final offers and receipt of best and final offers, one to two months; and (5) contract negotiation and award, one to two months.

The contracting process could be developed in several ways to expedite the overall project completion schedule. In addition to the two mentioned in the Title II design activity

discussion in Section 5.1.2.4 (design-build, and phased construction), the project could be separated into sections (e.g., breaking the alignment into separate request for proposals of approximately 72.4 km/45 miles each), and separate contracts could be awarded for each section to maximize contractor resources. Additional construction management support is required when using this contracting method. Multiple contracts development will require a longer schedule duration for contractor selection than a single contract development; closer to 12 months than 8 months.

The contractor selection process schedule could be shortened by about three months by performing the request for proposal development activities during the Title II design period. With this strategy, however, the request for proposal packages will have to be constantly updated and revised to incorporate changes made to the design during Title II. Also, the contracting strategy will have to be determined prior to the completion of the Title II design to allow the construction activities to be correctly divided into the request for proposal package scopes of work.

5.2.1 Construction Activity Duration — Historical Support Data

Construction is estimated at 2 to 2½ years based on historical data for similar types and sizes of rail construction projects. A database of Morrison-Knudsen historical rail and heavy-haul road construction projects with lengths of 40.2 km (25 miles) or greater was compiled to determine a construction duration. The construction duration was based on dividing any alternative route into approximately 72.4-km (45-mile) construction segments, constructed concurrently. Selection of one alternative over another would not significantly change the estimated construction schedule, as the schedule is based on concurrent construction of equal length. For example, eight crews working eight 70.8-km (44-mile) sections on the 571.2-km-(355-mile-) long Caliente alignment would complete the project on about the same schedule as three crews working three 67.6-km (42-mile) sections on the 204.3-km- (127-mile-) long modified Jean alignment.

Previous rail construction projects of similar terrain type and construction strategy are shown in Table 5-2. The projects were evaluated to determine the actual schedule duration for both design and construction, to allow comparison to the estimated schedule duration for this study. The comparison shows that the estimated schedule durations are sufficiently conservative for this stage of the study.

5.2.2 Expediting Strategies for Construction Activities

Methods for expediting the construction, in addition to those discussed in Section 5.2.1, include:

- Increasing the number of sections being worked concurrently.
- Working additional shifts, up to three eight-hour shifts, seven days per week.
- Increasing the number of work fronts — start construction from both ends and work towards the middle.

Table 5-2. Historical Data for Rail Design and Construction

Project Description	Year	Length (Miles)	Morrison-Knudsen Scope of Work		Design Schedule (Months)	Construction Schedule (Months)	Total Schedule (Months)
			Design	Construction			
Baltimore Light Rail Project Maryland Mass Transit Administration Baltimore, Maryland	1993	27	X	CM	24	32	56
Amtrak Northend Electric Project National Railroad Passenger Corporation Boston, Massachusetts	Under Construction	72	X	X	32	31	63
Black Mesa and Lake Powell Railroad Salt River Project Page, Arizona	1974	78	X	X	26	22	48
Fence Lake Project Salt River Project St. Johns, Arizona	Proposed	43	X	CM	16	22	38
Cerrejon Port Railroad* INTERCOR/Exxon Republic of Colombia	1986	90	X	X	14	28	42
General Santos Road* Republic of Philippines Mindanao, Philippines	1994	110	X	X	14	22	36
Santee Light Rail Transit-505 Extension Metropolitan Transit San Diego, California	1994	3.5	X	CM	24	26	50
Yucca Mountain Transportation OCRWM	Proposed	120 to 400 (Estimated)	X		30 (Estimated) **	36 (Estimated)**	66 (Estimated)

* Projects designed and constructed in Colombia and the Philippines did not have permitting requirements to significantly affect the schedule. Those projects show a much shorter schedule duration than projects designed and constructed in the United States.

** Includes six-month contractor selection period.

- Awarding construction contracts early for long-duration activities such as bridge construction.

- Procuring long-lead time materials early, or maintaining large quantities of stock materials (such as rails). Materials could be purchased directly and supplied to contractors as government-furnished equipment.

- Completing all access agreements and right-of-way actions prior to contract awards.

Expediting the construction activities increases the risk of higher costs due to rework required to connect separately constructed segments together, interferences between contractors, loss of productivity due to congestion and shift work, and logistics problems in supplying multiple construction fronts.

5.2.3 Cost Drivers for Construction

The major cost driver related to the total cost for rail construction is the length of the rail line. The major material cost drivers for construction include (1) earthwork and rock excavation, (2) ballast processing and transport, (3) grade separations, (4) track and ties, and (5) drainage structures. These materials constitute the majority of the rail material construction costs. Evaluation of options for each material cost must be made to produce a cost-effective design.

For example, an evaluation of wood ties versus concrete ties must be made to identify which option offers the better value. Identification of the tie option will affect the cost evaluation of the ballast supply, because some ballast material acceptable for wood ties is not acceptable for concrete ties (Association of American Railroads 1993).

The ballast supply will require a detailed evaluation of available borrow sources along the preferred alignment. Processing requirements for ballast will be a major cost factor. Ballast transport distance will also be a major cost driver.

Access to construction areas may become a major cost driver if lengthy access roads are required to obtain access to isolated areas. Additional temporary land use permits may be required to access areas of construction, if schedule requirements make it necessary to begin construction of a railroad section on several fronts.

Grade separations and major drainage structures will produce the largest unit cost items, and construction of major structures may have to be expedited to ensure completion within the schedule period.

Because of the large quantity of common items such as rail and ties, procurement activities may have to be expedited to ensure a sufficient supply of those materials is available.

The Caliente route Conceptual Design Report preliminary cost estimate identifies the activities in Table 5-3 as major cost drivers (SAIC 1992). The table shows the estimated range of costs for each cost driver, shown as a percentage of the total estimated direct construction cost.

Table 5-3. Major Cost Drivers Identified by the Caliente Route Conceptual Design Report

Activity	Range of Cost (%)
Earthwork/rock excavation	44-49
Railroad track with ties	28-36
Grade separations/drainage structures	9-12
Ballast	3-4

More than 84 percent of the direct railroad construction costs are included in the four items listed. The ratios will be different for the other alternative routes because of differences in terrain, grade separation and drainage structure requirements, and total railroad length; however, the four items listed will constitute the bulk of the construction costs.

5.3 HEAVY-HAUL TRUCK DEVELOPMENT ISSUES

Heavy-haul truck transport of the MPC and high-level waste casks over existing state highways and secondary roads within the State of Nevada is feasible, and can be performed within the existing permit system for overweight and overlength loads. Although the state's permit system allows the heavy loads to be transported on state roads, their transport on a regular basis must be evaluated with the state and local agencies.

5.3.1 Intermodal Transfer

Transporting an MPC or high-level waste transportation cask from an existing rail line in Nevada to the Nevada Test Site by heavy-haul truck will require construction of an intermodal transfer facility adjacent to the existing railroad. This facility must be capable of transferring an MPC/transport container from a rail car to a heavy-haul truck. The crane must have a load capability of at least 150 tons, accomplished by a pair of mobile cranes, a jacking tower, or an overhead gantry crane. The estimated cost of designing and constructing an intermodal transfer facility is $2.6 million. An intermodal transfer station concept is shown in Figure 5-1.

5.3.2 New Roads or Road Upgrades

Depending on the route selected for heavy-haul truck transport, new road construction or upgrade of existing roads may be required. This work could be performed within the repository construction activities, requiring that the paving work be included in the EIS for the repository.

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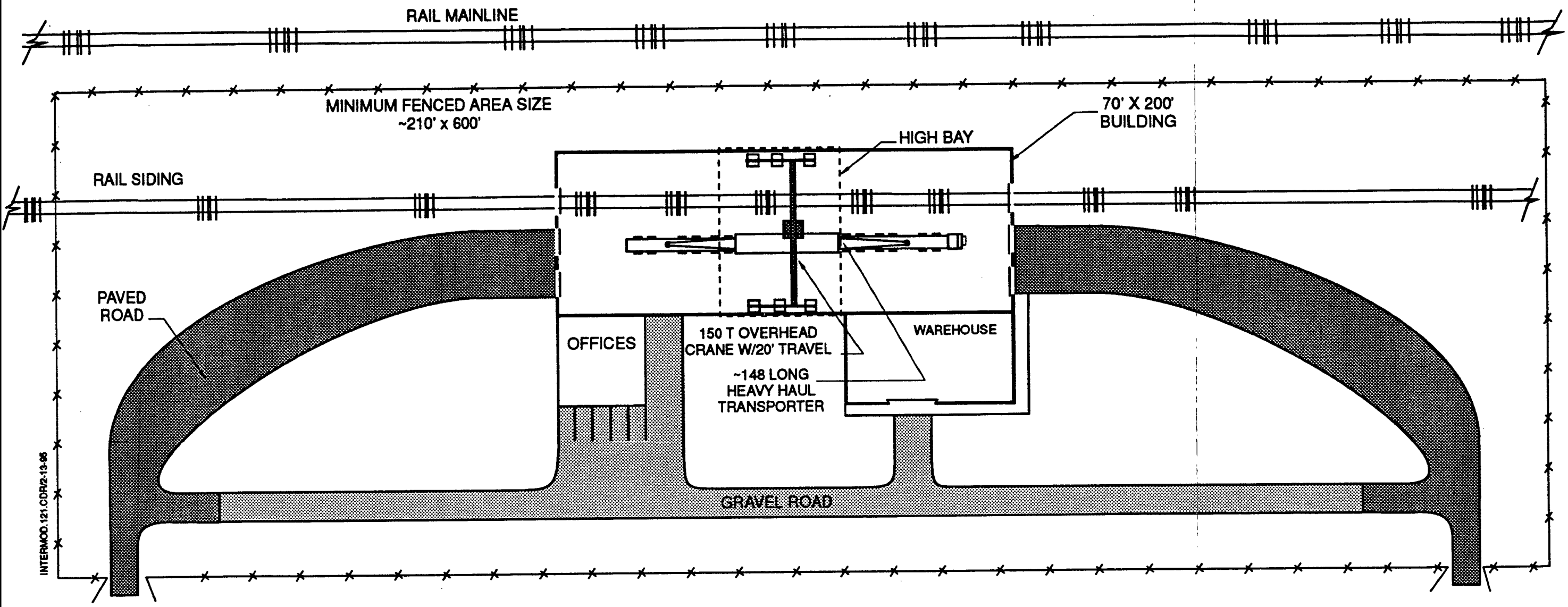

INTERMODAL TRANSFER STATION CONCEPT

Figure 5-1. Intermodal Transfer Station Concept

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6. SYSTEM OPERATION/RAIL MANAGEMENT APPROACH

The Caliente Conceptual Design Report (SAIC 1992) describes in detail the possible options for rail line ownership and operating scenarios. The report discusses the advantages and disadvantages of each management option, and concludes that additional evaluation of the options must be performed by DOE after a preferred route has been selected. The location of the main line connection, the identity of the direct main line carrier, the identity of indirect carriers, and the availability of train equipment for purchase or lease must be incorporated into the evaluation process prior to making a final decision on an approach. The following paragraphs provide a summary of the Caliente Report discussion.

Department of Energy Owned — Department of Energy Operated

This option allows DOE to have full control over the construction, management and operation of the railroad, except in those areas where other Federal and state regulatory requirements are mandated. This option includes purchase or lease of all train equipment, hiring of operation personnel, and full operation and maintenance of the track and equipment.

Department of Energy Owned — Shortline Operated

This option allows DOE to contract the operation of the railroad to an existing small carrier (shortline carrier) through a selection process. The bid would be awarded under a long-term contract to the lowest cost, qualified operator. The DOE would purchase or lease all train equipment, and the equipment would be assigned to the shortline carrier. The shortline carrier would be responsible for operation and maintenance of the track and equipment.

Department of Energy Owned — Privately Operated

This option is similar to the shortline operated option, except that the operation of the railroad would be contracted to a company other than an existing shortline carrier or Class I railroad. The contractor would be responsible for obtaining services of a carrier for operating and maintaining the track and DOE-owned equipment.

Department of Energy Owned — Class I Railroad Operated

In this alternative, the new rail line would become an extension of the connecting main line railroad, rather than being an independent carrier. The DOE would control the design and building of the railroad, and the railroad would be assigned to the Class I railroad carrier for operation and maintenance. The DOE would purchase or lease only train equipment specifically associated with transporting the casks. Union Pacific representatives have stated that they are not interested in designing, constructing, or operating the rail branch line.

Privately Owned — Privately Operated

Under this option, the DOE would control the design and building of the railroad and support facilities, purchase or lease train equipment, and establish operating procedures. The DOE would then sell or lease the rail line, facilities, and equipment to a private company, with a contractual agreement for the usage and maintenance of the railroad during the life of the DOE program.

7. INSTITUTIONAL ISSUES

This section discusses institutional issues that arise when considering transportation alternatives.

7.1 PUBLIC INVOLVEMENT IN DEVELOPING THE CALIENTE ROUTE CONCEPTUAL DESIGN

The development of the conceptual design of the Caliente route included extensive involvement of Nevada communities in the feasibility of the potential rail alignment options (SAIC 1992). Local officials along the potential route commented on the route evaluation process during meetings held in Caliente (Lincoln County), Goldfield (Esmeralda County), and Tonopah, Beatty, and Amargosa Valley (Nye County). By soliciting routing comments throughout the process, DOE determined that potential routes could be identified that best meet the needs of DOE and the local communities. Recommendations by Lincoln County, the City of Caliente, and Nye County were made in accordance with Section 5032 of the Nuclear Waste Policy Amendments Act of 1987.

The draft Conceptual Design Report was sent to all affected communities, the University of Nevada, the rail industry, and the State of Nevada for comments. The comments received were incorporated and the final report was also issued to those parties.

Recommendations made by local communities were and will continue to be included in rail route evaluation activities.

7.2 INSTITUTIONAL CONSIDERATIONS IN FUTURE DEVELOPMENT OF RAIL ACCESS

The Nevada Potential Repository Preliminary Transportation Strategy, Study 2, will include as its scope, holding meetings with the affected communities based on the method used in a report addressing the Caliente corridors (SAIC 1992). Representatives will also be told that the rail spur, if constructed, will be available for shared use, but that the local communities will have to determine the most effective ways to use the railroad (DOE 1991).

A key issue is the desire to divert rail transport of spent nuclear fuel and high-level radioactive waste from Las Vegas (on the Union Pacific main line).

7.3 INSTITUTIONAL CONSIDERATIONS IN FUTURE DEVELOPMENT OF LEGAL-WEIGHT TRUCK ACCESS

The DOE will follow DOT guidelines, including supporting efforts by the State of Nevada to keep truck routes out of the Las Vegas valley, especially away from the Interstate 15/ U.S. Highway 95 interchange. It must be stressed that identifying preferred alternate routes that will keep the shipments out of Las Vegas is the prerogative of the state, which the state recognizes.

In discussions with the public, YMSCO will continue to stress that the cask design and fabrication to NRC standards provide the appropriate safeguards for the public and the environment even in the event of the most severe credible accident. One of the issues that will be resolved will be the effects of any new Federal legislation on the highway transportation of spent nuclear fuel into Nevada. With the present plan to make maximum use of rail transport, there may only be 11 percent or less of the spent nuclear fuel shipped in legal-weight truck casks. If the maximum amount of spent nuclear fuel shipped by legal-weight truck casks is 11 percent or less, this would result in an average of less than 200 truck shipments per year or less than one per day over the estimated 24-year operation period for the repository.

7.4 INSTITUTIONAL CONSIDERATIONS IN FUTURE DEVELOPMENT OF HEAVY-HAUL ACCESS

There are two options to using heavy-haul truck transport from an existing rail line in Nevada to the potential repository site at Yucca Mountain. One option is over existing highways and the other is to build a separate heavy-haul access road from a rail siding to Yucca Mountain. The use of existing highways would require an intermodal transfer station close to the railroad and close to an existing good quality road. This would also require state permits.

It is anticipated that there would be a significant amount of public opposition to having large heavy-haul trucks on Nevada highways due to the perceived potential for serious accident consequences. It is also anticipated that there would be a significant amount of public opposition to locating an intermodal transfer station near a populated area because of the perceived risk of a drop accident during transfer.

7.5 EMERGENCY RESPONSE

A major institutional issue is emergency response training for first responders along the shipment routes for the spent nuclear fuel and high-level radioactive waste.

Because DOE is responsible for transportation of spent nuclear fuel and radioactive waste to a disposal site, DOE will develop a policy and procedures to implement Section 180(c) of the Nuclear Waste Policy Act of 1982, as amended. Section 180(c) requires DOE to provide "technical assistance and funds to states for training for public safety officials of appropriate units of local government and Indian tribes through whose jurisdiction the Secretary plans to transport spent nuclear fuel or high-level waste."

A Federal Register Notice of Inquiry to solicit comments on the scope and implementation of Section 180(c) was published January 3, 1995, requesting comments by April 1995. According to the Notice of Inquiry, "the DOE intends to implement a program . . . . the public are invited to comment." As part of its development of proposed policy and procedures, DOE is investigating other programs such as those developed by the Federal Emergency Management Administration, Federal Housing Authority, and Federal Railroad Administration to obtain information that will be evaluated and incorporated as applicable into the policy and procedures. Upon consideration of comments on the Notice of Inquiry, DOE

is scheduled to issue a Federal Register Notice. The current plan is to initiate funding for emergency response training three to five years prior to beginning shipments.

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8. STUDY RESULTS AND CONCLUSIONS

8.1 RESULTS

The results of this Nevada Transportation Study 1 indicate that there are four reasonable rail routes (with route options) and three reasonable heavy-haul truck routes available for further evaluation.

Rail Routes	Comments
Caliente	Identified as feasible in the Preliminary Rail Access Study (YMP 1990b).
Carlin	Identified as feasible in the Preliminary Rail Access Study.
Jean	Identified as feasible in the Preliminary Rail Access Study. Route options for Jean were added in this study for further evaluation. A small portion of the route is within a California Wilderness Area, requiring interagency agreements, or legislation, for right-of-way.
Valley Modified	Added in this study for further evaluation. Recent discussions with BLM have identified that the status of locations listed as Wilderness Study Areas (Quail Springs and Nellis WSAs) may change, based on BLM recommendations that these areas not be adopted as wilderness areas.

Heavy-haul truck transport is a feasible alternative to rail transport, but state regulations and institutional concerns have been identified that present significant obstacles for continuous long-term operation of heavy-haul transporters. All heavy-haul truck routes listed below are assumed, for the purposes of this study, to initiate from an intermodal transfer point in the Caliente/Elgin area of Lincoln County or in the Las Vegas area (Arden siding to Dike siding).

Heavy-haul Routes	Comments
U.S. Highway 93 to Nevada State Route 375 to U.S. Highway 6 to U.S. Highway 95	Existing roads – Nevada State Route 375, U.S. Highway 6 and a portion of U.S. Highway 95 cannot to be used for heavy-haul travel from February through April in accordance with Nevada Department of Transportation regulations. (Axle loadings would have to be reduced to legal weight limits). An additional option would use Kane Springs Road from Elgin to U.S. Highway 93, north to State Route 375. Kane Springs Road is currently dirt/gravel surface and would require upgrading to a paved surface.

U.S. Highway 93 to U.S. Highway 95	Existing roads – No Nevada Department of Transportation seasonal restrictions. High population densities along this route present increased institutional concerns about continuous, long-term operation of heavy-haul trucks through Las Vegas. This route could initiate in the Caliente/Elgin area or in the Las Vegas area. A portion of Interstate 15 may be used to travel from U.S. Highway 93 to U.S. Highway 95. Kane Springs Road could be an optional route from the Caliente/Elgin area to U.S. Highway 93.
State Route 160 from Arden to U.S. Highway 95	Existing roads – The Nevada Department of Transportation currently has a width restriction of 2.6 m (8 ft, 6 in) on State Route 160 from Arden to Pahrump. Future upgrade of State Route 160 may allow increased width limits. Currently, the department will not permit loads wider than 2.6 m (8 ft, 6 in) on that portion of State Route 160, unless there is no other route available.

The other rail route alternatives listed in the body of this study have been placed in one of two categories: (1) eliminated from further study, if that route was found to have a fatal flaw associated with the evaluation criteria developed in the Preliminary Rail Access Study (YMP 1990b); or (2) eliminated from detailed evaluation, but to be monitored for changes in conditions that would allow the route's status to be upgraded. The identification of these routes' current status is identified below.

Rail Routes Eliminated	**Comments**
Ludlow	Significant portion of the proposed route is in an area of California within the Wilderness Areas established in the 1994 California Desert Conservation Act. This change in land status places the Ludlow route in the category of "Eliminated from further study."
Crucero	Same status as Ludlow.
Mina	December 6, 1991, letter from the Walker River Paiute Tribe on the status of the portion of the rail line through the Indian Reservation confirms that the Walker River Paiute Tribe is contesting that right-of-way. This places the Mina route in the status of "Eliminated from detailed evaluation - monitor for change in status."
Valley	Additional land use conflicts associated with the finalization of the expansion of the Red Rock National Recreation Area have effectively eliminated the proposed Valley route from further study.

Arden	Additional land use conflicts associated with development of private property in northwest Las Vegas, and the finalization of the expansion of the Red Rock National Recreation Area, have effectively eliminated the proposed Arden route from further study.
Cherry Creek	"Eliminated from detailed evaluation - monitor for change in status," due to uncertainties with the Nevada Northern railroad; a privately-owned branch line. The proposed Cherry Creek route currently does not provide direct access to a major carrier. The existing line is constructed with 60-pound rail, which is too light for the proposed MPC loads.
Dike	The Valley Modified route uses the majority of the proposed Dike route, except for the initiation point, and was revised to route around the Sheep Mountain Bombing Range.
Lincoln County Options A and B	"Eliminated from detailed evaluation - monitor for change in status," due to land use conflicts with the Nellis Air Force Range. Verbal input from DOE has indicated that the land use status has not changed in the last five years.
Lincoln County Option C	"Eliminated from further study." The proposed route does not provide direct access to the potential repository site. This option was a combination of rail and heavy-haul truck that crossed the Desert National Wildlife Range.

8.1.1 Cost Evaluation

Cost evaluations of the route alternatives identified as reasonable were performed based on a unit cost ($/mile) basis plus unit costs for tunnels, drainage structures, and grade separations which were estimated separately. Therefore, the costs shown in this study are directly related to route distance. A more detailed cost analysis cannot be performed until the conceptual designs for the routes are complete, and quantities have been calculated. Major cost drivers have been identified in this study for design and construction costs.

Heavy-haul truck transport costs are lower than those for rail transport, as the heavy-haul options use existing roads, thus requiring minimal capital costs be expended to start transport operations. However, annual operation and maintenance costs for heavy haul will be higher than those for rail. Total life cycle costs for heavy-haul transport are estimated to be lower than those for rail transport. Operations and maintenance costs for heavy haul over a 24-year period based on preliminary information were based on an estimated operational cost of $15,000/trip, with 468 trips per year average (11,230 total trips), for an estimated cost of $171 million to $173 million, depending on the route used.

8.1.2 National Environmental Policy Act Process

The NEPA process has been evaluated to determine the advantages and disadvantages of a repository EIS that incorporates all transportation analyses, or a repository EIS that includes initial transportation analysis, with additional analyses performed separately. In either case, transportation conceptual design must begin in 1996.

8.2 EVALUATION CRITERIA

This study has proposed criteria applicable for evaluation and comparison of the rail routes. This proposed criteria will be refined in the next systems study for developing the final criteria that will be used to select a preferred route. The evaluation criteria were also applied to the heavy-haul truck routes identified in this study to provide comparisons to rail routes. The criteria include:

- Areas of favorable topography
- Land use conflicts
- Ease of construction
- Capital investment cost
- Safety
- Flexibility for personnel and freight
- Operating and maintenance costs
- Safeguards and security
- Public perception.

The four rail routes recommended for detailed evaluation and the three reasonable heavy-haul routes identified in this study are listed in Table 8.1 and have been comparatively evaluated against the criteria listed above. The evaluation criteria matrix in Table 8-1 was developed to show the comparative favorable and unfavorable attributes of each proposed route, as compared to the other alternatives. The matrix is not intended to be used for selecting a preferred route alternative; it was developed to identify, in tabular form, the conclusions of the study. A neutral designation (o) was assigned to route attributes that have no significant advantages or disadvantages when compared to the other alternatives. A positive value (+) was assigned to the route attributes judged to be significantly favorable to the other routes, and a negative value (—) was assigned for significantly unfavorable attributes. The values were assigned qualitatively by the study team, based on the information included in the study text. The positive and negative values shown in the Table 8-1 matrix are summarized in Table 8-2. The evaluation criteria proposed in this study will be supplemented with additional criteria in the next systems study, and additional criteria identified in the NEPA scoping process, to develop a sufficient criteria base to select a preferred route.

Evaluation criteria for route selection and design will be finalized based on comments received during the NEPA scoping process after all affected groups have been allowed to provide input.

Table 8-1. Matrix of Reasonable Rail and Heavy-Haul Routes to the Evaluation Criteria

Route	Areas of Favorable Topography	Land Use Conflicts	Ease of Construction	Capital Investment Cost	Safety	Flexibility for Personnel and Freight	Operating and Maintenance Costs	Safeguards and Security	Public Perception
Rail									
Caliente - Option B	o	+	o	—	o	—	—	o	o
Carlin - Monitor Valley and Smoky Valley Options	o	o	o	—	o	—	—	o	o
Jean - Wilson Pass and Table Mountain Option	—	o	—	+	o	o	o	o	o
Jean - State Line Pass Option	o	—	o	+	o	o	o	o	o
Valley Modified	+	—	+	+	o	+	o	o	—
Heavy Haul									
U.S. 93 -S.R. 375-U.S. 6-U.S. 95*	—	o	o	+	—	—	o	—	—
U.S. 93-U.S. 95**	+	o	o	+	—	—	o	—	—
S.R. 160 from Arden to U.S. 95	—	o	o	+	—	—	o	—	—

* Optional use of Kane Springs Road

** Optional use of Caliente/Elgin area or Las Vegas area for intermodal transfer. Optional use of Kane Springs Road.

\+ Indicates route has favorable attributes for that criteria item

— Indicates route has unfavorable attributes for that criteria item

o Indicates route attribute is not obviously favorable or unfavorable

Table 8-2. Discussion of Evaluation Criteria Matrix

Route	Positive Attributes	Negative Attributes
Caliente	**Land use conflicts**: The Caliente route, as identified in the text, has minimal known land use conflicts compared to the other proposed rail routes. The route traverses BLM land almost exclusively, except for a section near the Goldfield area, where DOD land may have to be traversed to avoid private land in that area.	**Initial cost**: The initial cost for construction of the 587.3-km-(365-mile-) long Caliente route is significantly higher than the shorter Valley Modified and Jean routes (due to route length). **Flexibility for personnel and freight**: The Caliente route is not flexible for use in carrying freight and personnel from the Las Vegas area, which would be the primary intermodal transfer point for the primary uses (Nevada Test Site, Air Force, Yucca Mountain). The Caliente route initiates in a remote area and traverses remote areas, limiting flexibility. **Operating and maintenance (O&M) costs**: Due to the route length, O&M costs will be significantly higher than the shorter routes. Maintenance of way costs and operating costs, possibly requiring crew changes, constitutes a significant disadvantage for a long route.
Carlin	No significantly positive attributes were identified.	**Initial cost, flexibility for personnel and freight, and O&M costs**: Disadvantages for those attributes for the Carlin route are similar to those identified for the Caliente route due to similar route length and remoteness of the route corridor to heavily populated areas.

Table 8-2. Discussion of Evaluation Criteria Mix (Continued)

Route	Positive Attributes	Negative Attributes
Jean — Wilson Pass and Table Mountain Option	**Initial cost**: The Jean Route options are approximately one third the length of the Caliente and Carlin routes and have been preliminarily estimated to have significantly lower initial costs than the longer routes.	**Areas of favorable topography**: The Jean route options through the Spring Mountains are significantly affected by the rugged terrain and rate of elevation change, even within the existing pass areas of Wilson Pass and Table Mountain Pass. The rugged terrain will require long stretches of rail line grade approaching maximum grade, affecting safety and operations efficiency. **Ease of construction**: The route through the rugged Spring Mountain area will significantly affect construction in the areas of cost, schedule, equipment requirements, and access. The Jean route options through the Spring Mountains would require that more complex construction be used.
Jean — California State Line Pass Option	**Initial cost**: See Jean options above.	**Land use conflicts**: A significant land use conflict for the Jean route - California State Line Pass option is that the route traverses the newly established Wilderness Area through State Line Pass.

Table 8-2. Discussion of Evaluation Criteria Mix (Continued)

Route	Positive Attributes	Negative Attributes
Valley Modified	**Areas of favorable topography**: The Valley Modified route follows the Las Vegas Valley along US 95 directly to the potential repository site and provides significant advantages over the other route alternatives for the attribute. **Ease of construction**: The favorable topography, ease of access due to having US 95 directly adjacent, and convenience of transporting equipment, materials, and labor to the rail line construction areas from Las Vegas and the Nevada Test Site are significant advantages for the Valley Modified route over the other route alternatives, which would be constructed in more remote, rugged areas. **Initial cost**: Because the Valley Modified route is the shortest route and there is little impact due to rugged terrain, the initial cost of the Valley Modified route has been preliminarily estimated to be significantly lower than the other route alternatives. **Flexibility for personnel and freight**: The Valley Modified route initiates in Las Vegas and provides the shortest, most direct route to the site. The route could also be designed to provide rail service directly to the Air Force Auxiliary base in Indian Springs and to Mercury. The other routes initiate too far away from Las Vegas to allow them to be used effectively for personnel transport, and the routes, by necessity, access the potential repository site from the west and south, bypassing areas of the DOE and DOD that may benefit from rail access.	**Land use conflicts**: The Valley Modified route has significantly more known and potential land use conflicts than the other route alternatives. The conflicts include DOD Air Force land in North Las Vegas, Indian Springs and Nellis Wilderness Study Areas, the proposed traditional lifeway between the Las Vegas Paiute Indian Reservation and the Wildlife Refuge to the north, and the proposed expansion of North Las Vegas. Conflicts with the proposed Las Vegas Beltway would also have to be addressed. **Public perception**: The Valley Modified route would be constructed and operated through the densely populated Las Vegas area, and the trains would be visible from US 95 for most of the route length. The land withdrawn for the rail line would limit the expansion potential of North Las Vegas. The rail line would pass directly north of the Paiute Indian Reservation. All radioactive waste shipments would pass through the Las Vegas area. Construction activities for the rail line may cause visual impacts (i.e., dust and noise) in the Las Vegas Valley.

Table 8-2. Discussion of Evaluation Criteria Mix (Continued)

Route	Positive Attributes	Negative Attributes
(1) US 93; SR 375; US 6; US 95 (2) US 93; US 95 (3) SR 160 from Arden to US 95	**Initial cost**: Initial cost is a significant advantage for all heavy-haul truck routes over rail routes, as the heavy-haul trucks will operate over existing roads. No major initial construction costs would be expended, except for the costs to design and construct an intermodal transfer facility at the rail siding. **Areas of favorable topography**: The US93/US95 route option is the most favorable of the alternative heavy-haul routes due to its gentler grades and fewer established transport restrictions.	**Areas of favorable topography**: This attribute, as applied to heavy-haul truck routes, compares the truck routes for the steepness of the grades on existing roads and accepted year-round use by the Nevada Department of Transportation. The SR 160 route option requires trucks to traverse the Spring Mountains. This road is currently restricted by Nevada Department of Transportation; loads over 2.6 m (8 ft, 6 in) in width are not permitted. **Safety**: Statistics from the Association of American Railroads (1993) identify that rail transport of hazardous materials is safer (fewer accidents per ton-mile) than truck transport of hazardous materials. All heavy-haul truck routes have been given a negative value for safety, as compared to rail. **Flexibility for personnel and freight**: Heavy-haul truck transport would not be effective for transporting either freight or personnel. All heavy-haul truck transport has been given a negative value for flexibility, as compared to rail. The intermodal transfer process would also require an additional heavy lift of the casks during the transport period, increasing safety concerns. **Safeguards and security**: Because heavy-haul trucks would operate on public roads, security is more difficult than with a dedicated rail line. All heavy-haul truck transport has been given a negative value for security, as compared to rail.

Table 8-2. Discussion of Evaluation Criteria Mix (Continued)

Route	Positive Attributes	Negative Attributes
(Continued) (1) US 93; SR 375; US 6; US 95 (2) US 93; US 95 (3) SR 160 from Arden to US 95		**Public perception:** Public perception of heavy-haul trucks transporting radioactive waste shipments over public highways and through cities and towns would be significantly more negative than transporting by rail, which would bypass population areas (with the exception of the Valley Modified rail route) and be separate from areas frequented by the public.

8.3 SCHEDULE SHOWING ACTIVITY TIES AND DURATIONS

The repository completion schedules are based upon the NEPA process, repository licensing, and repository construction as the primary drivers and the transportation system design, contractor selection, land access, and construction tasks needed to support that process. Figure 8-1 shows the preliminary schedule for receiving waste by 2010, assuming EIS development requires additional EIS analysis for the transportation system. Figure 8-2 shows the preliminary schedule for receiving waste by 2010, assuming EIS development does not require additional EIS analysis for the transportation system.

The schedule shows both rail and heavy-haul design and construction activities. This study has assumed that either rail or heavy haul (but not both) will be selected during the EIS process, and the system not selected will be deleted from the schedule at that time. However, if expediting the waste shipments became an overriding concern, using heavy-haul trucks during rail construction would be a viable alternative.

8.4 RECOMMENDATIONS FOR FURTHER WORK

The following recommendations identify subsequent study activities to be performed to resolve data gaps in Study 1.

- Research existing data on current land use status within the route corridors, and identify details of current and planned use that may impact route selection. Land use concerns include private property, patented mining claims, unpatented mining claims, wilderness areas, grazing lands, traditional lifeway areas, recreation management areas, existing right-of-way corridors, areas of environmental concern, and DOE and DOD land use status.

- Evaluate alternative routes and design and construction schedules to determine the feasibility of using the transportation system for purposes other than waste transport. Other uses include support of repository construction, freight and personnel transport to Yucca Mountain and the Nevada Test Site facilities, use by mining and other business concerns, and possible future usage following repository closure.

- Evaluate transport requirements for empty disposal casks (overweight loads) and incorporate that evaluation into the route selection process.

- Develop more detailed data on route delineation within the proposed route corridors, based on land access research results.

- Identify route-specific requirements for environmental impact studies, based on more detailed delineation of routes within the corridors.

- Obtain funding for performing rail conceptual designs in fiscal year 1996.

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YUCCA MOUNTAIN RAILROAD/HEAVY HAUL TRUCK TRANSPORTATION SCHEDULE
*(EIS D*evelopment with Additional EIS Analysis)

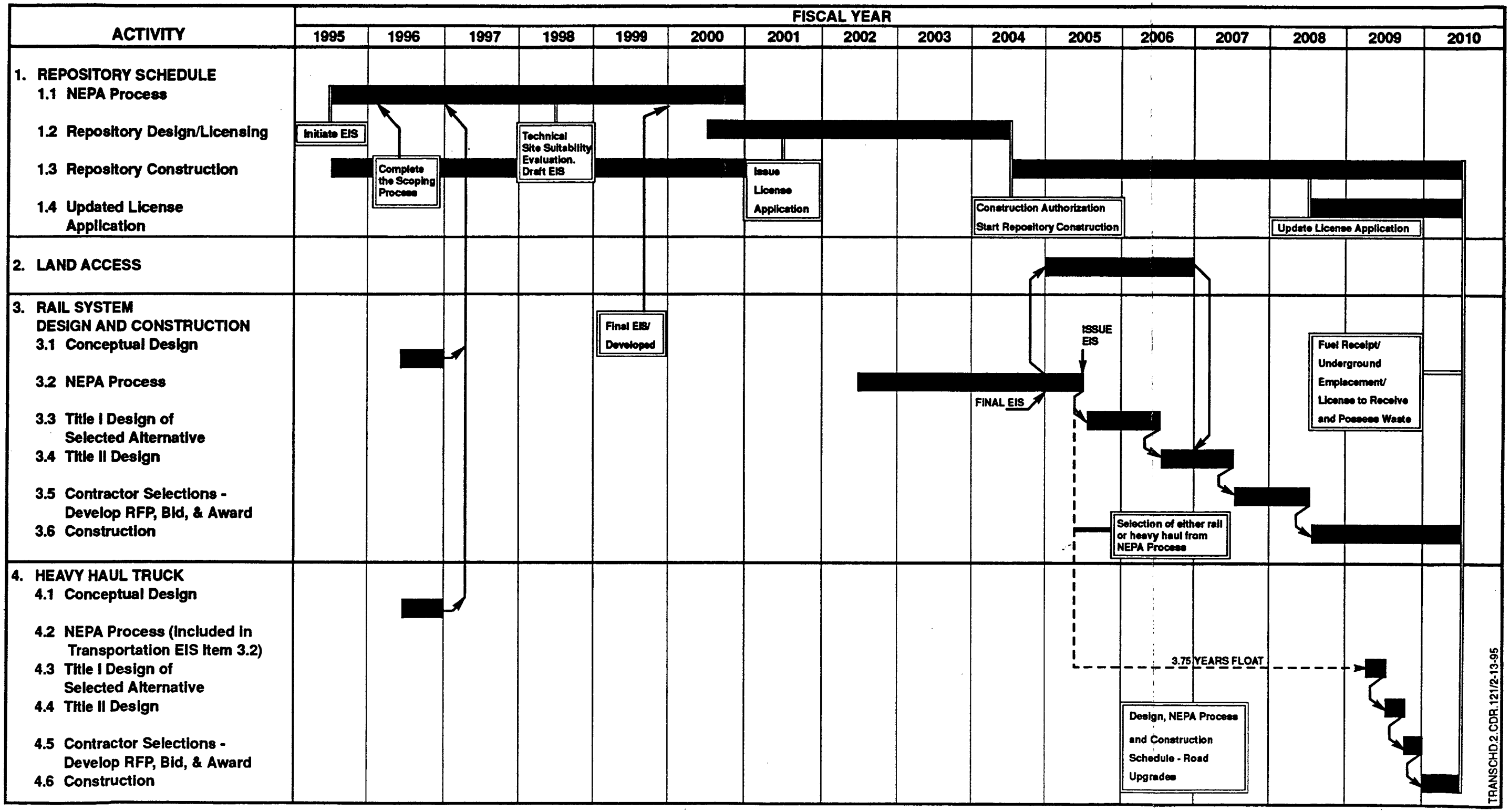

Figure 8-1. Transportation Schedule — Environmental Impact Statement Development with Additional Environmental Impact Statement Analysis

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YUCCA MOUNTAIN RAILROAD/HEAVY HAUL TRUCK TRANSPORTATION SCHEDULE

(EIS Development with no Additional Analysis)

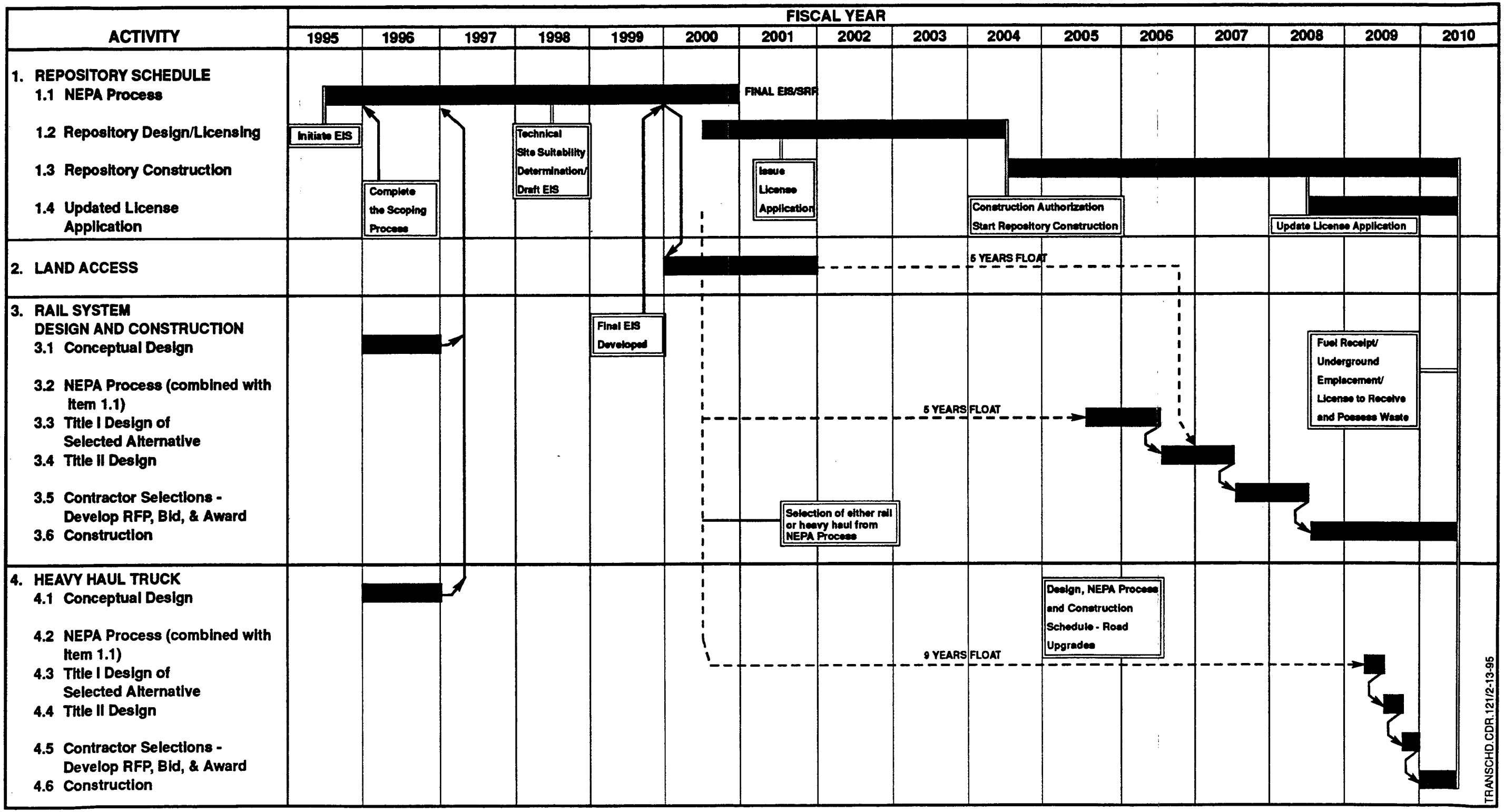

Figure 8-2. Transportation Schedule — Environmental Impact Statement Development with No Additional Environmental Impact Statement Analysis

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9. DEFINITIONS

Affected unit of local government — The unit of local government with jurisdiction over the site of a repository or monitored retrievable storage facility. This term may, at the discretion of the Secretary of Energy, include units of local government that are contiguous with the primary unit.

Association of American Railroads — An organization advocating the interests of railroads in the public policy arena. The association works to enhance the productivity of the railroad industry through research and development, and other support programs. The organization facilitates a seamless intermodal interchange by electronically exchanging information among railroads, their customers, and their suppliers. Although the association's most visible activity is representation of its members before Congress, regulatory agencies, and the courts, most employees and budget are focused on operations, maintenance, safety, theoretical and applied research, economics, finance, accounting, communications, electronic data exchange, and public affairs.

Barge — A non-self-propelled vessel.

Civilian Radioactive Waste Management System (CRWMS) — The composite of sites, facilities, systems, equipment, materials, information, activities, and personnel required to perform those activities necessary to manage spent nuclear fuel and high-level radioactive waste disposal.

Commercial high-level radioactive waste — The high-level radioactive waste, as defined by Nuclear Waste Policy Act Section 2(12), resulting from reprocessing spent nuclear fuel in a commercial facility.

Dedicated train — Train service, as opposed to regular train service, that may include certain restrictions such as consisting of a locomotive, caboose, buffer cars, one or more cars of radioactive, and no other freight; may not travel at any time faster than 56.3 km (35 miles) per hour; and must stop when it meets, passes, or is passed by another train. Special routing restrictions may also apply in which the railroad will attempt to avoid highly populated areas. As a separately operating train with its own crew, the special train will avoid some rail yards and sidings that are engaged in railcar switching.

Disposal — The isolation of radioactive wastes from the accessible environment. As defined by 10 CFR 60.2, disposal is the emplacement in a repository of high-level radioactive waste, spent nuclear fuel, or other highly radioactive material with no foreseeable intent or recovery, whether or not such emplacement permits the recovery of such waste.

Disposal package or waste package — The primary container that holds, and is in contact with, solidified high-level radioactive waste, spent nuclear fuel, or other radioactive materials, and any overpacks that are emplaced at a repository.

Hazardous material (HAZMAT) — Any solid, liquid, or gaseous material that is toxic, flammable, radioactive, corrosive, chemically reactive, or unstable upon prolonged storage in quantities that could pose a threat to life, property, or the environment. (This definition is applicable to U.S. Department of Energy orders and is distinct from the term "hazard material substance" defined in Section 101(14) of Comprehensive Environmental Response, Compensation and Liability Act of 1980 and in 40 CFR 300.6.) Also defined by 40 CFR 171.8 as a substance or material designated by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce and which has been so designated.

Heavy-haul truck — Also referred to as truck "super loads" that are over 58,514 kg (129,000 pounds) and which require a state permit.

High-level radioactive waste — The highly radioactive waste material that results from the reprocessing of spent nuclear fuel in a commercial or defense facility, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains a combination of transuranic waste and fission products in concentrations requiring permanent isolation.

Highway route controlled quantity — A quantity within a single package which exceeds: (1) 3,000 times the $A_1$1 value of the radionuclides as specified in U.S.C. § 173.433 for special form radioactive material; (2) 3,000 times the $A_1$2 value of the radionuclides as specified in U.S.C. § 173.433 for special form radioactive material; or (3) 30,000 curies, whichever is least.

Highway routing (of highway route controlled quantity) — Refers to those routes which must be selected by the carrier or that person operating a motor vehicle containing a highway route controlled quantity of radioactive materials to reduce time in transit and minimize radiological risk. The route is limited to a preferred route or a state-designated alternative route whenever possible and must be in writing with a copy supplied to the driver and shipper, the latter being notified in writing of any deviations.

Indian tribe — Any Indian tribe, band, nation, or other organized group or community of Indians recognized as eligible for the services provided to Indians by the Secretary of the Interior because of their status as Indians.

Intermodal transfer — The physical transfer of a piece of cargo from one mode of transportation (e.g., highway, rail, or barge) to another to effect continuous movement of the shipment to destination without releasing the contents.

Legal-weight truck — A truck cask system consisting of a tractor, semitrailer, and loaded cask, with a maximum gross weight of 36,288 kg (80,000 pounds). Special permits are not required for legal-weight truck shipments.

Legal-weight truck cask — A cask of a size that, when combined with the rest of the transport system, will not exceed the legal-weight truck limits.

Local government — Any county, city, village, town, district, or political subdivision of any state, Indian tribe or authorized tribal organization, or Alaska Native village or organization, including any rural community or unincorporated town or village or any other public entity.

Multi-purpose canister (MPC) — Sealed, metallic containers maintaining multiple spent nuclear fuel assemblies in a dry, inert environment and overpacked separately and uniquely for the various system elements of storage, transportation, and disposal.

National Environmental Policy Act (NEPA) of 1969 — The Act that established the national policy to protect man and the environment, requiring environmental reviews of Federal actions that have the potential for significant impact on the environment, and established the Council on Environmental Quality.

Nuclear reactor — An apparatus, other than an atomic weapon, designed or used to sustain nuclear fission in a self-supporting chain reaction.

Nuclear Regulatory Commission (NRC) — The Federal agency responsible for regulating commercial nuclear power plants and other commercial nuclear operations pursuant to the Atomic Energy Act of 1954, as amended, and covered by provisions under Section 170(a) of that Act. This Federal agency has a broad statutory authority over transportation of radioactive material similar to that of the Department of Transportation. Under a memorandum of understanding between the two agencies, however, NRC limits its activities to performing safety evaluations of packages and issuing certificates of compliance for Type B packages and packages for fissile material. The NRC prescribes rules for monitoring of packages on receipt, for limiting the exposure of individuals to ionizing radiation, and for in-transit security of certain materials. NRC imposes Department of Transportation shipping requirements by reference and inspects against them, and enforces those requirements.

Nuclear Waste Policy Act (NWPA) — An Act passed in 1982, and reauthorized in 1987, that directs the Department of Energy to design, site, and construct a geologic repository for the disposal of defense high-level radioactive waste and spent fuel from civilian (commercial) nuclear reactors. The NWPA also established the Office of Civilian Radioactive Waste Management to carry out these responsibilities.

Overweight truck — A truck cask system consisting of a tractor, semitrailer, and loaded cask with a gross vehicle weight in excess of 36,288 kg (80,000 pounds), but not more than 58,514 kg (129,000 pounds), varies by state. Each state will issue a permit based on individual weight computation formulas.

Preferred route — A preferred route consists of (1) an interstate system highway for which an alternative route is not designated by a state routing agency, and/or (2) a state-designated route selected by a state routing agency in accordance with the Department of Transportation "Guidelines for Selecting Preferred Highway Routes for Highway Route Controlled Quantity Shipments of Radioactive Routing Materials," or an equivalent routing analysis.

Prime mover — The vehicle providing motive power to the transporter.

Producer — Any generator of high-level radioactive waste resulting from atomic energy defense activities or any producer of vitrified commercial high-level radioactive waste.

Radioactive waste — Solid, liquid, or gaseous material that contains radionuclides regulated under the Atomic Energy Act of 1954, as amended, and of negligible economic value considering costs of recovery.

Railroad — Classifications based on traffic density/utilization measures which are indicative of the level of maintenance and investment applied to various rail line classes. All common carrier railway lines are subject to the Federal Railway Administration regulations intended to promote safety on the rail network.

> Main line — Class A: A traffic density measure of 20 million gross tons or more per year per route or route segment.
>
> Main line — Class B: A traffic density measure of at least 5 to less than 20 million gross tons per year or route segment.
>
> Branch line — Class A: A traffic density measure 5 million gross tons or more per year per route or route segment.

Repository — Any system licensed by the Nuclear Regulatory Commission that is intended to be used for, or may be used for, the permanent deep geologic disposal of high-level radioactive waste and spent nuclear fuel, whether or not such system is designed to permit the recovery, for a limited period during initial operation, of any materials placed in such a system. Such term includes both surface and subsurface areas at which high-level radioactive waste and spent nuclear fuel handling activities are conducted.

Reservation — Any Indian reservation or dependent Indian community referred to in clause (a) or (b) of Section 1151 of Title 18, United States Code; or any land selected by an Alaska Native village or regional corporation under the provisions of the Alaska Native Claims Settlement Act (43 U.S.C. 1601 et seq.).

Right-of-way — Public lands authorized to be used or occupied pursuant to a right-of-way grant.

Right-of-way grant — An instrument issued pursuant to Title V of the Federal Land Policy and Management Act authorizing the use of a right-of-way over, upon, under, or through public lands for construction, operation, maintenance, and termination of a project.

Spent nuclear fuel — Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not separated by reprocessing [NWPA Section 2(23)] [10 CFR 961.11]. Specifically, in this document, spent nuclear fuel refers to (1) intact, nondefective fuel assemblies; (2) failed fuel assemblies in canisters; (3) fuel assemblies in canisters; (4) consolidated fuel rods in canisters; (5) nonfuel components inserted in pressurized-water reactor fuel assemblies including, but not limited to, control rod assemblies, burnable poison assemblies, thimble plug assemblies, neutron source

assemblies, and instrumentation assemblies; (6) fuel channels attached to boiling-water reactor fuel assembles; and (7) nonfuel components and structural parts of assemblies in canisters.

State-designated route — A preferred route selected in accordance with U.S. Department of Transportation Guidelines for *Selecting Preferred Highway Routes for Highway Route Controlled Quantities of Radioactive Materials* or an equivalent routing analysis which adequately considers overall risk to the public.

Traditional lifeway area — The 1980 amendments to the National Historic Preservation Act directed the Secretary of the Interior to preserve and conserve " . . . intangible elements of our cultural heritage . . . and encourage the continuation of the diverse traditional prehistoric, historic, ethnic, and folk cultural traditions that underlie and are a living expression of our American heritage. . . ." (National Historic Preservation Act Section 502; 16 U.S.C. 470a note). The principal method of accomplishing this direction is to invite cultural groups to provide information to this agency concerning sensitivity of cultural values on Federal lands. Those areas that are considered to exhibit values necessary for continuation of cultural rules of practice are called traditional lifeway areas or traditional cultural properties. The designations are based on the identification of certain areas by Native American groups and individuals as important for the operation of their respective religions and lifeways. These areas generally include the possession of archaeological features and materials and specific plants and animals. Evaluation of traditional lifeway areas or traditional cultural properties also addresses provisions of the American Indian Religious Freedom Act.

Once an area is designated by the district manager as sensitive, the information is used to identify and evaluate effects on cultural resources as the result of a Federal action (National Historic Preservation Act Section, 106). The areas are determined eligible for nomination to the National Register of Historic Places under 36 CFR 60.4(a). Regional Native American tribes and individuals have provided information on sensitive lands to this office. While Native Americans generally consider all their traditional lands as sensitive, they have participated in a process of evaluation that first selects the most sensitive acreage for designation as a traditional lifeway area.

Transportation cask — A container that meets all applicable regulatory requirements for shipping spent nuclear fuel and/or high-level radioactive waste.

Truck cask — A cask designed to be transported by highway. Current truck casks include the General Atomics GA-4 and GA-9 legal-weight truck casks. Each design includes a transportation cask assembly, a specially fabricated trailer, ancillary equipment (including lifting devices), special tools and fixtures, spare parts, and consumables.

Withdrawal — The withholding of an area of Federal land from settlement, sale, location, or entry under some or all of the general land laws for the purpose of limiting activities under those laws to maintain other public values in the area or reserving the area for a particular public purpose or program; or transferring jurisdiction over an area of Federal land from one department, bureau, or agency to another.

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APPENDIX A

ACRONYMS

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ACRONYMS

BLM	U.S. Bureau of Land Management
CFR	Code of Federal Regulations
CRWMS M&O	Civilian Radioactive Waste Management System Management and Operating Contractor
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
GA	General Atomics
GTM	gross ton miles
GVW	gross vehicle weight
MPC	multi-purpose canister
MTU	metric tons of uranium
NEPA	National Environmental Policy Act
NRC	Nuclear Regulatory Commission
NWPA	Nuclear Waste Policy Act of 1982, as amended
NWPAA	Nuclear Waste Policy Amendments Act
OCRWM	Office of Civilian Radioactive Waste Management
WSA	Wilderness Study Area
YMP	Yucca Mountain Site Characterization Project

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APPENDIX B

REGULATORY REQUIREMENTS FOR ROAD/RAIL TRANSPORTATION OF HIGH-LEVEL RADIOACTIVE WASTE TO THE YUCCA MOUNTAIN SITE

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Appendix B

Regulatory Requirements for Road/Rail Transportation of High-Level Radioactive Waste to the Yucca Mountain Site

Regulatory Category	Permitting/ Regulating Agency	Citation	Description of Regulation Requirements	Issues of Concern
Clean Air Act	Nevada Division of Environmental Protection	USC 7401-7642; 40 CFR 50-53, 58, 60-61, 81.300-81.400	The authority to regulate radioactive air emissions has been retained by the Environmental Protection Agency; however, Nevada has authority to implement Prevention of Significant Deterioration program of the Clean Air Act. Need Air Quality Permit to Construct if more than 8.1 ha (20 acres) of land per year are disturbed. Operating Permit for point sources may be required for equipment.	Fugitive dust control for construction sites. Operating permits for drilling rigs, cement, batch plants, etc.
Federal Water Pollution Control Act	Clean Water Act Water Quality Act	33 USC 1251-1376; 33 CFR 209, 320, 323-330; 40 CFR 110, 112, 115, 116, 121, 122-125, 129, 133, 135, 230, 401, and 403	State of Nevada has permit authority.	
Safe Drinking Water Act	Nevada Division of Health	42 USC 300F-300J-10; 40 CFR 124, 141, 143	(Not expected to be applicable to construction phase activities; however, may be relevant for an intermodal transfer facility.) All public drinking water supplies must meet the requirements of Nevada Administrative Code 445.244 to 445.262 and the National Primary Interim Drinking Water Regulation (40 CFR 141) and secondary standards established by Nevada Administrative Code 445.248.	

Regulatory Category	Permitting/ Regulating Agency	Citation	Description of Regulation Requirements	Issues of Concern
Permit to Appropriate Public Waters of Nevada	Nevada State Engineer	NRS 533.335	Obtain a Water Appropriation Permit. Comply with State Environmental Commission prescribed controls on diffuse sources of pollutants (runoff is a diffuse source; however, it will not seriously degrade any waters of the State). Consult with Nevada Water Pollution Control Laws for applicable requirements.	Water appropriation will be necessary for dust control.
Clean Water Act	Nevada Department of Environmental Protection/Bureau of Water Pollution Control	33 CFR 209, 320, 320.2(G), 323-330; 40 CFR 110, 112, 115, 116, 121, 122-125, 129, 133, 230, 401, and/403	Obtain National Pollutant Discharge Elimination System permit for storm water discharges. Obtain a Nationwide General 404 permit from the U.S. Army Corps of Engineers to dredge, fill or modify navigable waters or waters of the United States. Comply with permit monitoring requirements (if any).	National Pollutant Discharge Elimination System storm water permit for construction sites.
Wetlands Protection	U.S. Army Corps of Engineers	Executive Order 11990, 10 CFR 1022 CWA 404 40 CFR 230 33 CFR 320-330	Determine if construction will adversely affect wetlands. Prohibits discharge of dredged or fill material into wetlands without permit.	
Water Resources	U.S. Fish and Wildlife Service Nevada Department of Wildlife	Fish and Wildlife Coordination Act (16 USC 661 et seq.) 40 CFR 6.302(e)	Requires Federal agencies involved in action that will result in the control or structural modification of any natural stream or body of water to protect the fish and wildlife resources. Must consult with the U.S. Fish and Wildlife Service and Nevada Department of Wildlife.	
Navigable Waters	U.S. Army Corps of Engineers	CWA (33 USC 1251-1376), 40 CFR 230, 231, 33 CFR 323	Requires permits for discharge of dredged or fill material into navigable waters.	

Regulatory Category	Permitting/ Regulating Agency	Citation	Description of Regulation Requirements	Issues of Concern
Endangered Species	U.S. Fish and Wildlife Service	16 USC 1531 50 CFR 402, 40 CFR 6.302(h) 50 CFR 17	Prohibits Federal agencies from jeopardizing threatened or endangered species or adversely modifying habitats essential to their survival. If a species may be affected, U.S. Fish and Wildlife Service must be consulted.	Desert tortoise, a threatened species, inhabits the Yucca Mountain site.
National Environmental Policy Act		42 USC 4321-4361; 40 CFR 1500-1508	Nuclear Waste Policy Act specifies compliance with National Environmental Policy Act.	
National Historic Preservation Act	National Environmental Policy Act	916 USC et seq; 36 CFR 60, 61, 63, 65, 67, 68, and 800	Work closely with Advisory Council of Historic Preservation, National Conference of State Historic Preservation Officers, and the State Historic Preservation Officers to develop a Programmatic Agreement for construction. Pre-construction surveys are required.	
Antiquities Act		16 USC 431, 432, and 433; 25 CFR 261; 36 CFR 296; 43 CFR 3 and 7	Comply with procedural terms of the Programmatic Agreement if protected objects are found.	
Archaeological Resources Protection Act		16 USC 471A A-47011; 36 CFR 296; 43 CFR 7	Compliance with the terms of the Programmatic Agreement. Make every practicable effort to identify archaeological resources and provide for their protection before excavation begins.	
American Indian Religious Freedom Act of 1978	American Indian Religious Freedom Act		The Programmatic Agreement developed with the Advisory Council on Historic Preservation describes the steps to be taken by the Department of Energy to ensure compliance with the American Indian Religious Freedom Act. Consult with Bureau of Indian Affairs and local tribes.	
Hazardous Material Transportation Act	U.S. Department of Transportation and Nevada Department of Transportation	49 USC 1801-1812 49 CFR 171-178	Comply with applicable U.S. Department of Transportation regulations. Consult with U.S. Department of Transportation and Nevada Department of Transportation.	

Regulatory Category	Permitting/ Regulating Agency	Citation	Description of Regulation Requirements	Issues of Concern
U.S. Department of Transportation		49 CFR 100-177 10 CFR 71-73	No permits required for legal weight trucks; however, heavy loads may require a permit.	U.S. Department of Transportation defines criteria for route selection (i.e., must maximize use of interstate highways). States have prerogative to select alternative routes. May adopt fee structure for shipment of high-level radioactive waste in the state. Heavy-haul and overweight trucks have increased requirements for Emergency Response Training regulated under the Nuclear Waste Policy Act. Additional requirements include restrictions on transporting hours and days.
Nevada Department of Transportation	Nevada Department of Transportation	NRS 459.705, 484.737, 484.738, and 484.739	Obtain permits for oversized vehicles.	Nevada Department of Transportation has the authority to limit heavy load travel on highways. Nevada Department of Transportation also has restrictions on size, length and weight for heavy-haul vehicles and may require special permits and additional restricted hours and days for movement of oversized loads on highways.
Noise Control Act		42 USC 4901-4918; Executive Order 12088	Control and monitor noise levels in accordance with the Noise Control Act.	
Resource Conservation and Recovery Act	State of Nevada	42 USC 6901-6987	Compliance process under Resource Conservation and Recovery Act for small-quantity waste generators.	
Nevada State Wildlife Statutes		NRS 501.105-110; NAC 503.010-503.080	Consult Nevada Department of Wildlife. Conduct biological studies and obtain permits for capturing or removing protected species.	Desert tortoise, a threatened species, inhabits the Yucca Mountain site.

APPENDIX C

PREVIOUS TRANSPORTATION STUDIES

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PREVIOUS TRANSPORTATION STUDIES

Feasibility Study for Transportation Facilities to the Nevada Test Site

The U.S. Atomic Energy Commission issued a report titled, "Feasibility Study for Transportation Facilities to Nevada Test Site" (1962). The study was a preliminary determination of the technical and economic feasibility of constructing and operating a railroad short-line from the vicinity of Las Vegas (Wann siding) to Mercury and then on to Jackass Flats in Area 25 at the Nevada Test Site. The study indicated that the short-line railroad concept was technically and economically feasible. The cost of the rail line was estimated at $12,323,000 and could be amortized in about 6-1/3 years. The rail line was never built; instead DOE supported Clark County, Nevada, in the construction of a four-lane divided highway (U.S. Route 95) from Las Vegas to Mercury to maximize safe transportation for the Nevada Test Site workers.

Preliminary Nevada Transportation Accident Characterization Study

The DOE report "Preliminary Nevada Transportation Accident Characterization Study" (YMP 1990a) characterized and documented highway and rail accidents in the State of Nevada. The findings presented in the report are used to:

- Identify safety problems that exist in the current transportation system
- Refine input data to probabilistic risk assessment and route selection computer models
- Identify areas for promoting safety throughout the transportation system.

The report compares accidents in Nevada with those in the United States as a whole because national statistics may be appropriate to use in some situations, especially where the sample size for Nevada is small.

The report's findings include the following issues:

- Since 1974 the amount of travel on Nevada's highways has grown faster than the national average.
- Nevada's fatal highway accident rate has been consistently higher than the national average and showed a sharp increase in 1987 and 1988, whereas the national rate has steadily decreased.
- Nevada's highway accident injury rate is lower than the national average.
- Speed and defective vehicles were the two most important factors contributing to truck accidents.

- Rail accidents in Nevada and in the rest of the nation show a decline in recent years.

- The most common type of rail accident, both nationally and in Nevada, is derailment; the second is collision.

- Nevada differs dramatically from the rest of the country in the causes of rail accidents. In Nevada the two most common causes of accidents were mechanical/electrical and human factors, responsible for 39 percent and 30 percent, respectively. National data show that 39 percent of all accidents are attributed to track/roadbed causes with human factors second at 29 percent.

- Most rail accidents, both in Nevada and nationally, occur at very low speed.

The most apparent differences between Nevada and the rest of the nation appear to be related to the relatively large portion of Nevada rail lines that are in open country where higher operating speeds are maintained. Nevada shows a slightly higher number of high-speed rail accidents than the national average. Also, a larger percentage of its accidents are caused by failure of equipment and by human factors, which can be mitigated by early recognition and corrective action.

Nevada Commercial Spent Nuclear Fuel Transportation Experience

The DOE report "Nevada Commercial Spent Nuclear Fuel Transportation Experience" (YMP 1991a) presented an historic overview of commercial spent nuclear fuel shipments that have occurred in Nevada and reviewed the accident and incident experience for this type of shipment. Between 1964 and 1990, 309 truck shipments covering approximately 64,374 km (40,000 miles) and 15 rail shipments covering approximately 10,461 km (6,500 miles) moved through Nevada. Of the 64,374 km (40,000 miles) of shipments on Nevada roadways, 95 percent were on interstate highways.

Because the data for Nevada are limited, national data for spent nuclear fuel transportation and the safety of truck and rail transportation in general were assessed. In addition, due to the low number of shipment miles of spent nuclear fuel, it was recommended by the study team that general accident rates be used in future safety and risk assessments, a conservative approach is because of the more stringent requirements placed on truck drivers, their training, and more frequent and thorough inspections on the transporters than on general trucking companies.

Preliminary Rail Access Study

The Preliminary Rail Access Study (YMP 1990b) identified 10 rail alignment options from existing rail lines in Nevada to Yucca Mountain. Also, Lincoln County and Caliente identified three additional alignments which were addressed in the study. Each of the options were reviewed to identify land-use compatibility issues. They were placed in one of three categories: having existing conflicts that are not likely to change prior to DOE needing access, having potential conflicts, or having no identified conflicts. Based on a detailed

review of current ownership patterns and development criteria, the Caliente and Jean alignments were found to have no significant land-use conflicts, and the Carlin alignment was judged to have the least potential for serious conflicts.

These three routes were recommended for further engineering evaluation with the objective of not excluding access to any of the three regional rail carriers. The remaining 10 alignments will continue to be monitored for changes in land access conflicts.

As identified in the rail access study, the route alternatives selected for consideration as potential rail access alignments to the Yucca Mountain site will be identified and discussed as part of the Environmental Impact Statement (EIS) scoping process.

The study report is divided into a description of the routes, evaluation of the routes for carrier access, and a discussion of land-use compatibility for each of the options, including the three recommendations from Lincoln County and the recommendations for further evaluations. Also included in the report is a table of the lengths of each alignment and the costs, including capital and operating and maintenance costs. The capital costs included the cost of track work at $310,700 per km ($500,000 per mile) and grading, fencing and appurtenances totaling $310,700 per km ($500,000 per mile) in flat to rolling terrain. In mountainous terrain, an additional $621,400 to $745,600 per km ($1 million to 1.2 million per mile) was allotted for increased grading and drainage.

The operating cost calculations estimated a cost of $10.38 per 1,000 gross ton km ($16.70 per 1,000 gross ton miles [gtm]).

The maintenance costs were estimated to be $3,194 per track km ($5,140 per track mile) equivalent to an additional operating cost of $50.15 per 1,000 gtm. This estimate was based on a projected tonnage of 102,000 gross tons per year.

Estimates ranged from a low of 159.3 km (99 miles) in length, $142 million capital cost, and $0.74 million annual operating and maintenance costs for the Valley option to a maximum of 720.8 km (448 miles) in length, $735 million capital cost and $3.3 million annual operating and maintenance costs for the longest of the Caliente alignments. These costs are in 1988 dollars, and do not include contingency, engineering, administration, construction management, or planning.

Study of Nevada Rail Characteristics

The DOE report "The Nevada Railroad System: Physical, Operational, and Accident Characteristics" (YMP 1991b) provides a description of the operational and physical characteristics of the Nevada railroad system. The first part is a narrative description of all main line and major branch lines of the Nevada railroad system. Each Nevada rail route is described, including the route's physical characteristics, traffic type and volume, track conditions, and history. The second part provides a more detailed analysis of Nevada railroad accident characteristics than was presented in the "Preliminary Nevada Transportation Accident Characterization Study" discussed in Section 1.2.2.

Caliente Route Conceptual Design

In June 1992 the final Caliente Route Conceptual Design Report was issued (SAIC 1992). The scope of the study was to develop the conceptual design, provide preliminary environmental analysis and prepare a cost estimate for the Caliente alignment. This study included an environmental screening to aid in route siting. The conceptual design also included the design of an access highway from U.S. Highway 95 in Amargosa Valley to the potential site at Yucca Mountain, about 25.7 km (16 miles) away.

Two possible routes from the vicinity of Caliente to the potential site at Yucca Mountain were developed which constituted an envelope of possible routes between Caliente and Yucca Mountain. Approximately 1,167 km (725 miles) of rail alignment were included in the detailed study.

Information was developed on engineering factors including distance, grade rise and fall, the amount of cut and fill required, curvature, drainage and rail operations. Alignment maps on a horizontal scale of 1 in = 500 ft and a vertical scale of 1 in = 50 ft were developed for the alignment studied. A hydrology study was conducted to evaluate worst case run-off flows for a 100-year flood condition. Environmental constraints were evaluated to compliment the engineering tradeoffs in route locations to assure that the base route and options did not traverse environmentally sensitive areas. In addition, archaeological studies were conducted to assure that the potential route and options did not traverse restricted, historical, archaeological or cultural sites.

The study evaluated five potential operational options: DOE owned, DOE operated; DOE owned, short line operated; DOE owned, contractor operated; DOE owned, Class I railroad operated; and privately owned, privately operated. Engineering, construction and operating costs were developed for each of the operational options.

The results of the rail study indicate that there is a potential feasible rail route, with several options, from the existing Union Pacific railroad in the Caliente area to the potential repository site at Yucca Mountain. Conceptual plan and profile evaluations indicate that this route can be constructed within the limitations of present railroad engineering practices and is within normal operating standards. The base cost of doing the detailed design and constructing the railroad is $1,008 million in 1990 dollars.

High-Speed Surface Transportation Between Las Vegas and the Nevada Test Site

Raytheon Services of Nevada (RSN) issued a draft report "High Speed Surface Transportation Between Las Vegas and the Nevada Test Site" (RSN 1994). The report explored the rationale for a potential high speed rail corridor between Las Vegas and the Nevada Test Site to accommodate increased workers. The study looked only at a passenger train from the vicinity of U.S. Highway 95 and Ann Road in northwest Las Vegas to Mercury and Control Point 6 on the Nevada Test Site with another branch line to Yucca Mountain. The people mover was not connected to any existing railroad line. The line would include 185 km (115 miles) of main line track plus sidings and passing turn-outs. There would be two train sets of one engine and six passenger cars each with four terminals on the line. The total cost of

constructing the rail line and the associated equipment was $964 million. No follow-up to this study has been initiated.

Nevada Highway Routing Study

The DOE study "Nevada Highway Routing Study" (DOE 1989) identified possible points of entry into Nevada, intrastate access routes, and an estimate of the number of highway shipments of spent nuclear fuel to Yucca Mountain. Alternate routes were also identified that could benefit the Yucca Mountain Project and could be designated by the State of Nevada under U.S. Department of Transportation (DOT) regulations. The routes that are described do not represent DOE's identification of preferred routes.

The study fulfilled three purposes:

- To provide a description of current highway routing regulations applicable to DOE
- To identify possible highway routes in Nevada
- To disseminate shipping rate information.

Yucca Mountain Project Study

The DOE report "Nevada Highways: Physical Conditions and Safety Experience" (YMP 1991c) presented a more detailed analysis of Nevada highway accident characteristics than the "Preliminary Nevada Transportation Accident Characterization Study." The report:

- Compared the physical and operating characteristics of Nevada's highway system to those of the rest of the country
- Described combination truck (tractor pulling one or more trailing units) accidents in detail
- Identified locations in Nevada where combination truck accidents have been concentrated
- Characterized accident patterns on the major highways in Nevada.

Based on the analysis of the highway performance management system data, Nevada's highways are generally better constructed than highways in the rest of the nation. Two areas of concern are grades and shoulder width on rural arterials. Although Nevada highways experience roughly the same accident involvement as the rest of the country, accidents in Nevada are generally more severe. In general, from the data, it would appear that offpeak hours during daylight conditions would be the safest for travel by large trucks in Nevada.

Nevada Department of Transportation Study

Nevada Assembly Bill No. 47 required the Nevada Department of Transportation to conduct an analysis of the risk involved in the transportation of "highway route controlled quantity" shipments of radioactive materials and high-level radioactive waste within the state. Nevada

Department of Transportation was also required to develop and enforce a plan for routing shipments of highway route controlled quantity of radioactive material. The action was in response to concerns about the potential consequences of an accident involving radioactive materials.

The University of Nevada, Reno, was contracted by Nevada Department of Transportation to perform a study to comply with the legislative requirements. A three-phased work plan was developed and approved by Nevada Department of Transportation. Phase I of the study determined the nature of highway transportation of highway route controlled quantity within the state and included a review of Federal, state, and local regulations. A Phase I report was distributed to the appropriate state and local officials in July, 1988. Phase II included a search of existing routing and risk computer models and provided a preliminary identification of alternative routes that could be used to transport highway route controlled quantity of radioactive materials. A Phase II report was issued in December, 1989 (Nevada Department of Transportation 1989). Phase III will include informational meetings with Federal government agencies, state agencies, regional organizations, tribal leaders and bordering states. By September 1995 data will be updated, comment responses will be provided, and an analysis methodology described in DOT guidelines will be prepared and resubmitted to California. Public meetings have been held as part of the Phase III effort. After the information from these meetings has been incorporated into the study, Nevada Department of Transportation's director will designate the preferred alternative routes and these will be the routes that will be used for future shipments of highway route controlled quantity of radioactive materials.